Colonial Agro-Industrialism. Science, Industry and the State in the Dutch Golden Alkaloid Age, 1850-1950

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Colonial Agro-Industrialism. Science, Industry and the State in the Dutch Golden Alkaloid Age, 1850-1950

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(met een samenvatting in het Nederlands)

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"Not fleets threaten with destruction, not armies who unroll bloody banners, not conquests by sword and destruction; no, it is foremost conquests in the sphere of knowledge and civilization in every branch of the natural science, which are in the honour of humankind."[1]

"We desire, that the Dutch cinchona cultivation shall continue to deserve fully the name, which was given it shortly after its introduction in Java, viz., "a pearl in the crown of the Netherlands."[2]

[1] Vriese 1855, 6.
[2] Kerbosch 1931, 209.

Introduction: Cinchona, Quinine and Colonial Agro-Industrialism

This thesis is about what I call the Dutch Golden Alkaloid Age between roughly the 1850s and 1950s. I follow the historical trajectory of the production and distribution of the anti-febrifuge cinchona bark tree (*Cinchona officinalis Lin.*) and its most powerful and therapeutically applied alkaloid in the Dutch empire—quinine, an antimalarial medicine. During this period, scientists, planters, traders, industrialists and state officials in the Netherlands and the former Dutch colony of the Netherlands Indies cooperated in the establishment of a profitable and exploitable Dutch transoceanic cinchona-quinine enterprise, which would ultimately control and dominate the international quinine markets. Since the introduction of the cinchona bark tree (also known as Peruvian Bark, Jesuits' Powder and/or the "miraculous" Fever Tree) into Western medicine in the mid-seventeenth century, it has been lauded in classic medicinal histories as the prototype of a "specific" remedy against intermittent fevers (i.e. malaria), the predecessor and source of the therapeutically effective alkaloid quinine and a prime example of the transfer of medical knowledge and drugs from the New World to the Old World.[1] In this thesis, I show that the introduction and acclimatization of the cinchona bark tree in the Netherlands Indies and the subsequent emergence of a commercial cinchona cultivation and Dutch quinine industry across the Dutch colonial empire at the turn of the twentieth century was a process of a coevolution of science, commerce, industry and the (colonial) state within the context of what Toine Pieters and I branded as colonial agro-industrialism.[2]

Since the earliest Spanish and Portuguese voyages of discovery, naturalists have sought profitable plants for king and country and personal and corporate profit. In the Spanish Atlantic Empire of the early modern period, collecting plants and securing trade monopolies went hand in hand. In the Dutch Golden Age of the seventeenth century, science and commerce were closely integrated in the same search or drive for knowledge and wealth.[3] The scientific and commercial search for new natural knowledge brought botanists and other interested naturalists to the

[1] Maehle 1999, 223.

[2] Roersch van der Hoogte and Pieters 2013.

[3] Cañizares-Esguerra 2006, 7-8 and Cook 2007, chapter 1.

newly discovered and colonized lands. In return, these men exchanged their accumulated local knowledge with scientists and other interested practitioners in Europe thus creating networks of knowledge and practices between the European metropolis and the colonies.[4] Therefore, early modern botany designated as 'colonial botany' (the study, naming, cultivation, and marketing of plants in colonial contexts), both facilitated and profited from European colonialism and long-distance trade.[5]

During the eighteenth century, (botanical) interest in the flora and fauna of the New World became a significant aspect of European colonial expansion. Designated as 'green imperialism,' the search for profitable plants ('green gold') became imbedded in the expansion of the European colonial empires, commercial markets at home and abroad and the rising notion of mastering and controlling the natural world.[6] In these contexts, botany sat at the centre of a European colonial expansion that was a form of exchange, which was also a product of the coevolution of science and commerce. The result was the creation of a global network of botanical gardens supported by scientists, naturalists, and adventurists in search of this green gold.[7] From the mid-eighteenth century onward, botany developed into big business and industrial research programs as part of the emerging colonial empires and Industrial Revolution.[8]

The historical trajectory of the cinchona bark tree is an example of the search for 'green gold' and the transformation of botany into big business and big science during the second half of the nineteenth century. During the early modern period, concerns about the unpalatable and nauseating powdered cinchona bark-drug led to sustained efforts to identify and isolate the 'active principle' of the cinchona tree.[9] In 1820, the French pharmacists Joseph Bienaimé Caventou and Pierre-Joseph Pelletier were able to isolate the alkaloid quinine as the principle active component of the cinchona bark tree and subsequent studies of quinine

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[4] Harris 1998. For network-based models see Latour 1987.

[5] Schiebinger and Swan 2005, 3.

[6] Grove 1995, 1-15.

[7] Richard Drayton 2000, Schiebinger and Swan 2005, Grove 1995 and Cook 2007.

[8] Drayton 2000 and Harrison 2005, 56-63.

[9] Maehle 1999, 223-309.

showed the superior therapeutic properties of this pure alkaloid drug.[10] By the mid-nineteenth century, quinine had become the preferred medicine for the treatment of fevers and malaria. To meet the growing demand, pharmaceutical workplaces were transformed into modern factories for the mass production of quinine, thus stimulating the gradual establishment of a modern pharmaceutical industry during the mid-nineteenth century.[11] However, the harvests of the cinchona bark in the Andean nations of Peru, Ecuador and Bolivia were not sufficient to meet the new industrial demand for cinchona bark in Europe and the United States. Worse, European naturalists (like Alexander von Humboldt) warned that the destructive harvest methods of the Andean *cascarilleros* (bark collectors) would threaten the flow of sufficient cinchona bark to satisfy the exponentially growing demand for the malarial medicine, quinine.[12] They urged their governments, e.g., France, Great Britain and the Netherlands, to search for seeds and saplings of the cinchona tree and transport them to their colonies for cultivation.

As a result, the first cinchona bark tree was introduced on the Indonesia island of Java in 1852. In the next two decades, through a process of trial and error, Dutch state-sponsored pharmacists and chemists were able to introduce, acclimatize and finally commercialize the cinchona tree. By the late nineteenth century, the Netherlands Indies cinchona cultivation was positioned as the world's largest producer and supplier of cinchona bark, thus surpassing the natural supplies from the Andean nations and cultivated British cinchona from British India and Ceylon. In close connection with the Netherlands Indies' dominance of the worldwide cinchona bark supply, a Dutch quinine industry emerged at the turn of the twentieth century. The worldwide production of the semi-finished product quinine sulphate and the final medicine quinine had been controlled by the German pharmaceutical industry since the 1870s. Fifty years later, however, control over the production and distribution of quinine sulphate and quinine had shifted to a consortium of cinchona producers in the Netherlands Indies and three Dutch quinine manufacturers. By the late 1920s and early 1930s, this Dutch cinchona-quinine enterprise succeeded in dominating the first international pharmaceutical (quinine) cartel, that controlled the international cinchona and quinine markets.

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[10] Crawford 2009, Headrick 1988, Brockway 1979, Rocco 2003 and Honigsbaum 2000.

[11] Ziegler 2003, Liebenau 1987 and Wimmer 1994.

[12] Crawford 2009, Headrick 1988, Brockway 1979, Rocco 2003 and Honingsbaum 2000.

We know surprisingly little about the way in which the drive for commercial gain, scientific knowledge, and industrial production synergized during the late nineteenth and early twentieth centuries to initially secure and subsequently exploit the cinchona bark and its most important alkaloid, quinine, within the realm of the Dutch colonial empire. *How did the Dutch succeed in dominating the production and distribution of the raw material cinchona bark and henceforth control the industrial production of the antimalarial medicine quinine (despite the presence of the leading nineteenth-century German pharmaceutical industry)?* I argue that through a dynamic process of cooperation, exchange and interaction across the domains of science (specifically, pharmacy, botany and chemistry), commerce, industry, and state, the Netherlands was able to position itself as an agro-industrial superpower for cinchona and quinine.

This process can be branded as *colonial agro-industrialism*, referring to a colonial agro-industrial system whereby tropical crops were made exploitable and profitable by both governmental and private agricultural laboratories led and organized by university-trained scientists. Elite groups of policymakers, planters, bankers, and industrialists had come to realize that scientific knowledge and technical prowess were keys to wealth and power. This group of stakeholders recognized that efficient overseas-transport networks allowed tons of raw plant materials to be processed by large-scale industrial complexes using standardized technology, as well as expertise, capital, and distribution networks in the colonial motherland. Colonial agro-industrialism in continuation refers to a particular subset of the broader category of activity regarded as agro-industrialism. Agro-industrialism conceptualizes the development of a specific configuration of science and technology – particularly, the laboratory sciences – commerce, industry, and the nation-state within the context of the modernization process of the nineteenth and twentieth centuries. It can be argued that a similar industrial-agricultural system was in place in the various upcoming agricultural industries or 'agribusinesses' in, for instance, the southern United States (sugar, cotton, tobacco) by the beginning of the twentieth century. Planters' associations, in cooperation with the United States Department of Agriculture, established science-based technology, research and education centres, and modernized agriculture by establishing artificial selection and elaboration programs and other activities.[13]

[13] Fitzgerald 1991, 114-126, Daniel 1986 and Heitmann 1987.

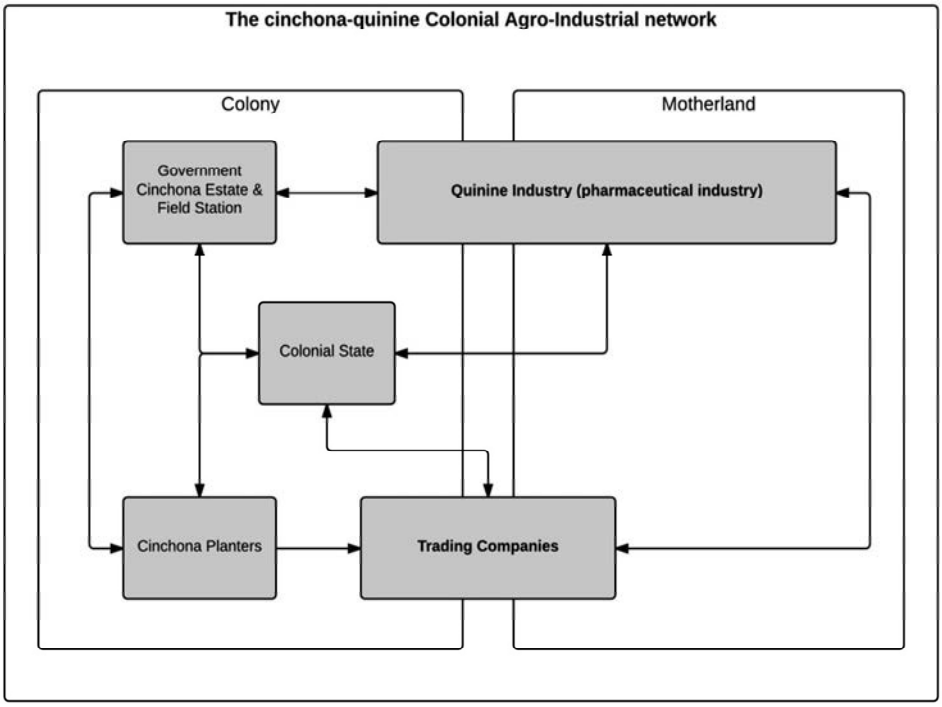

Figure 1: The cinchona-quinine Colonial Agro-Industrial network

Connecting Histories: The circulation of knowledge in a colonial and industrial context

This thesis aims to understand the emergence of the Netherlands as a major pharmaceutical producer and distributor of alkaloids – the extractions from natural raw materials ready to be used for the specialized production of therapeutic drugs – by the late nineteenth century and early twentieth century. Specifically, it aims to understand the emergence of the Dutch cinchona-quinine enterprise during the late nineteenth and early twentieth centuries and how five actors across the Dutch colonial empire (and hence Dutch cinchona-quinine colonial agro-industrial system or network) closely interacted, cooperated and exchanged knowledge and practices (see figure 1). The focus of my research in various historical archives was to determine how scientific knowledge, and specifically the introduction of the laboratory was central for connecting cinchona bark plantations in the Netherlands Indies with the quinine (pharmaceutical) industry in

Europe and in particular, the Netherlands. Henceforth, this thesis is not an in-depth historical analysis of the cinchona bark plantations in a colonial context, but rather an analysis of transoceanic interactions, cooperation and exchanges of knowledge and practices across the Dutch colonial empire. Therefore, this thesis is neither an economic historical study of the cinchona plantations, nor an agricultural history of the cinchona cultivation in the Netherlands Indies. Instead, it combines scientific-pharmaceutical history with colonial and industrial history. It takes into account the rise of modern science and technology and the introduction of laboratory sciences, especially for pharmacy and chemistry, in the constant effort to improve and standardize the quality of medicines and the rise of a modern pharmaceutical industry. Thus, it contributes to a better understanding of how scientific and technological developments influenced the development of the Dutch nation state as a modern, high-tech industrial state and the role of colonial (business) networks within the realm of the Dutch colonial empire.

By applying the analytical focal points of the 'circulation of knowledge' and the 'interaction between science and commerce,' this thesis touches on current research themes in the history of science and technology.[14] Two key assumptions in the historiography of science are that there is interaction between science and commerce and that science must be understood as a practice and culture in constant flux.[15] In recent decades, both historians of science and colonialism have convincingly shown that the production and dissemination of scientific knowledge needs to be understood by examining the multidirectional circulation of knowledge and practices between multiple centres and diverse peripheries in a colonial setting.[16] This especially applies for how encounters with the East and the New World influenced the intellectual shift of thought about nature in Europe and how medicine, botany and natural history were practiced during the early modern period. Historians of science, e.g., Harold Cook, Londa Schiebinger and Richard Grove, have emphasized the interplay between colonial trade networks and the circulation and production of knowledge during the early modern period by

[14] Pickstone 2001, Pickstone 2011, Dear and Jasanoff 2010, 759-774 Doel and Söderqvist 2006.

[15] Secord 2004. See also Pieters 2005.

[16] MacLeod 2000a, 1-13, Osborne 2000 and Schiebinger and Swan 2005, 52-55. See also Cook & Walker 2013, 337-351 and Cooper and Stoler 1997.

introducing historiographical concepts such as *colonial botany* and *green imperialism* in order to analyse these multidirectional dynamics between science and commerce.[17]

My thesis builds further on these aforementioned studies since it aims to understand how these processes of circulation of knowledge and interactions between science and commerce developed during the second half of the nineteenth and first half of the twentieth century as part of the rise of modern science (especially the laboratory sciences), industrialization and the modern nation state. By focusing on the dynamic interaction between the development of the cinchona and quinine businesses in the Dutch colonial empire and the development of a pharmaceutical industry in the Netherlands and Germany at the turn of the nineteenth and twentieth century, this thesis henceforth differs from existing studies regarding nineteenth and twentieth century Dutch science and technology and colonial historiography.

In recent decades both economic and business historians as well as historians of science have turned to the question of how science and technology influenced the economic growth of companies, nation states, multinationals, etc.[18] The relationship between economic performance and scientific and technological knowledge is also a central theme in the comprehensive and detailed study, *Technology and the making of the Netherlands. An Age of Contested Modernization, 1890-1970*. In the various chapters, Dutch historians of science and technology argue how the development ('modernization') of the Netherlands as a modern industrial nation state was guided, embodied and explicitly propagated by a wide array of actors ranging from scientific engineers, politicians, and economists to management consultants, architects and artists.[19] Jasper Faber and Ernst Homburg, for example, have argued that during the first decades of the twentieth century, cross-connections between economic performance and scientific-technological knowledge production and dissemination created the foundation for the emergence of a Dutch knowledge society after the Second World War.[20]

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[17] Schiebinger and Swan 2005, Cook 2007 and Grove 1995.

[18] See, for an overview, Freeman and Soete 1997-2000. According to Joel Mokyr, "the growth of knowledge is one of the central themes of economic change, and therefore alone it is far too important to be left to the historians of science." Mokyr 2002, 1.

[19] Schot, Lintsen and Rip 2010, 15.

[20] Baggen, Faber and Homburg 2010, Faber 2001 and Homburg 2003.

The aforementioned studies have shown how the establishment of technical education centres, such as the Polytechnical School in Delft, educated a new generation of technical engineers and chemists who, as specialists, contributed to the establishment of high-tech Dutch industries with in-house research and development (R&D) facilities.[21] These studies also show how the First World War and Dutch neutrality at the time can be regarded as a major catalyst in the development of the Netherlands as a modern industrial state. Not only did the war conditions result in sizeable wartime profits for agriculture and industry, they also created substantial room for new forms of cooperation across government, business and academia.[22] In the case of the pharmaceutical sector in the Netherlands, for example, companies such as Organon, Brocades & Stheeman and Noury & Van der Lande began to establish their own industrial laboratories by hiring specialized and professional technicians and/or forming close scientific working relations with university-based scientists and laboratories.[23] These existing studies about the Netherlands' development as a modern nation state thus illustrate the interaction between government, industry and science in the country during the late nineteenth and first half of the twentieth centuries. However, they tell us surprisingly little about these same interactions across the Dutch colonial empire and the way colonial agricultural production sites contributed to the industrialization of the Netherlands.

In a colonial context, considerable scholarly work has been dedicated to the application of science and technology in the development of the sugarcane industry in the Netherlands Indies and the role of science and technology in the development of the Netherlands Indies as a colonial state.[24] Andrew Goss and Suzanne Moon, for example, have shown how the interactions between natural scientists (foremost biologists) and the colonial state created strong research institutions, such as the Botanical Garden at Buitenzorg, in service of the colonial

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[21] Faber 2001, 18-22, Homburg, Rip and Small 2000, 305-307 and Baggen, Faber and Homburg 2010, 261-280.

[22] Schot and Rip 2010, 22-23, Sluyterman 2005, 75-91, Homburg, 2003 and Kruizinga 2012.

[23] Tausk 1984, 11-19, Oudshoorn 1999, Rinsema 2000, Faber 2001, 193-250, Homburg, Rip and Small 2000 and Huijnen 2011.

[24] Leidelmeijer 1997, Maat 2010, Knight 2013, Goss 2011, Moon 2007 and Schoor 2012.

export agriculture.[25] In other studies, Harro Maat and Wim van der Schoor have illustrated how university-trained biologists and agronomists travelled to and from the Netherlands Indies exchanging knowledge regarding tropical agriculture.[26] Historians like Margaret Liedelmeijer and Roger Knight have shown how the sugarcane industry's scientific and technological developments were central in making the colonial sugar industry one of the largest in the world.[27] However, these studies tell us little about the cross-connections between the scientific and technological development of the Netherlands Indies colonial state and tropical agriculture or the developing Dutch modern state in the context of the Dutch colonial empire. An exception is Robert-Jan Wille's recent dissertation, in which he analyses the "triangular-relationship" between science, imperialism and (Dutch) nationalism during the late nineteenth and early twentieth century.[28]

In the past few decades, scholars have argued convincingly that the Dutch expansion in the Indonesian archipelago during the late nineteenth and early twentieth centuries can be regarded as imperialism.[29] A central characteristic of this Dutch imperialism was the domination of business interests in the expansion of the Dutch empire, foremost in the Netherlands Indies.[30] Historians of colonialism like Thomas Lindblad and Maarten Kuitenbrouwer have shown how colonial business interests in export commodities like sugarcane, coffee and tea at the turn of the twentieth century were crucial in expanding Dutch colonialism in the Netherlands Indies and thereby building colonial business networks between the Netherlands and Netherlands Indies.[31] According to Remco Raben, we can speak of the 'webbedness' of the Dutch colonial empire by the early twentieth century.[32] However, apart from pointing at the importance of the networks of interests across the Dutch colonial empire, these studies refrain from making strong connections to the role of science and technology in the development of these colonial business networks across the Dutch empire.

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[25] Goss 2011 and Moon 2007.
[26] Maat 2001 and Schoor 2012.
[27] Leidelmeijer 1997 and Knight 2013.
[28] Wille 2015.
[29] Kuitenbrouwer 1998.
[30] Raben 2013.
[31] Kuitenbrouwer and Schijf 1998, Taselaar 1998, Lindblad 2002 and Van Zanden 2010.
[32] Raben 2013, 16.

In the chapter "Technology and the Colonial Past" in the volume *Technology and the making of the Netherlands*, Harro Maat has made a first attempt to connect aforementioned historiographies by asking what the exact nature of technology development in the colony (Netherlands Indies) was in relation to the specific legacy of colonialism in the Netherlands and in the former colonies. However, he adds, "because the whole issue of colonization and decolonization in relation to technology development largely involves uncharted terrain in colonial historiography, this chapter can only be exploratory in nature."[33] Recently Robert-Jan Wille's dissertation on the "triangular-relationship" between science, imperialism and nationalism has been a next step in connecting aforementioned historiographies.[34] To understand the emergence of the Netherlands as a major pharmaceutical power and specifically the emergence of the Dutch dominance of the first international pharmaceutical (quinine) cartel, this thesis connects the hitherto separate historical narratives by combining the history of the Dutch modern nation state with the history of science and technology and the history of colonialism and Dutch imperialism.[35]

In the introduction article of the special issue of the *Journal of Colonialism and Colonial History*, titled "Imperial Histories and Connected Histories of Empire," Simon Potter and Jonathan Saha argue that a fruitful cross-fertilization can be accomplished between imperial and global histories in terms of "connected history."[36] They challenge historians to treat the various parts of the world not as discrete entities, but rather as entangled histories of already connected people, places, things, ideas and images and study the exchanges and interactions that linked those places together.[37] Potter and Saha conclude their exploration of connecting global and imperial historiographies by hoping to produce accounts that combine an awareness of large-scale and global transfers and power formations and inequalities with an understanding of the roles played by human

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[33] Maat 2010, 325.

[34] Wille 2015, 24-28.

[35] A similar line of investigation, "a model based on a complex web of exchanges and interconnectedness," has been proposed by David Arnold in regard to technology and colonialism in an European context. Arnold 2005, 99.

[36] Potter and Saha 2015.

[37] Subrahmanyan 1997 and Bright and Geyer 2012. Cited in Potter and Saha 2015.

agency, chance and contingency in shaping the imperial past.[38] This thesis accepts the challenge and using the example of the Dutch cinchona-quinine pharmaceutical enterprise shows how by connecting the hitherto separate historical narratives of the Dutch modern nation state with the history of science and technology and the history of colonialism and Dutch imperialism, similar accounts of large-scale and global transfers, and roles played by scientists, industrialists and state officials operated across the Dutch transoceanic colonial empire.

Knowledge circulation, standardization and cartelization in a pharmaceutical industrial context

Alkaloids have played a central role in the early development of the pharmaceutical industry in Europe and the United States. The first alkaloid to be isolated was the *principium somniferum* from the opium plant by the German pharmacist Friedrich Sertürner in 1804, which he named morphine two years later.[39] The name alkaloid (German: *Alkaloide*) was introduced in 1819 by the German chemist Carl Friedrich Wilhelm Meißner, and is derived from the Latin word alkali and defined as a nitrogenous organic compound, which has pharmacological effects on humans and animals. Numerous alkaloids were isolated in the following decades by pharmacists across Europe, such as caffeine and quinine in 1820, nicotine in 1828 and cocaine in 1860.[40] The chemical isolation of these pure medicinal plant substances opened the way for a new generation of university-trained pharmacists and chemists in Europe (foremost France and Germany) and North America to establish the mass production of a whole new range of pharmaceuticals.[41]

By the second half of the nineteenth century, the (Western) medical markets witnessed the rapid growth of the packaged patent medicine industry (so-called nostrum-makers), however, this industry was characterized by the medical profession as a threat to society and public health.[42] In this climate, "ethical"

[38] Potter and Saha 2015.
[39] Hesse 2002, 313.
[40] Aniszewski 2007, 4, Sneader 2005, 88-89 and Hesse 2002, 316.
[41] Burhop 2008, Ziegler 2003, Liebenau, Higby and Stroud 1990, Bernschneider-Reif, Sabine, Walter Th. Huber en Ingunn Possehl 2002 and Homburg 1993.
[42] Huisman 1999, 453.

pharmaceutical companies successfully distinguished themselves from the producers of patent medicines by creating a trustworthy scientific image of drug innovation, drug standards, and medical progress. By presenting an image as gatekeepers of safe and effective drug development and distribution, these pharmaceutical companies allied with doctors and pharmacists and fought both patent-medicine producers and the practice of self-medication.[43] To ensure drug safety and efficacy, these companies created in-house laboratories where high-quality medicines were developed and tested.[44] The industrial focus on high-quality products, in turn, affected the demand for high-quality raw materials, thus introducing chemistry and laboratory sciences into (tropical) agriculture.

In the case of quinine as a health product, demands for standardization were articulated and explicitly communicated by a pharmaceutical industry striving for a scientific and trusted public image. This resulted in a growing interconnection between the production and export of a high-quality cinchona bark in and from the Netherlands Indies with the production and distribution of a high-quality quinine commodity by the European pharmaceutical industry. Therefore, this thesis serves as an exemplary case study of how the demands for standardization, rationalization and efficacy dramatically affected the development, production and distribution of plant-based medicines by the late nineteenth and early twentieth centuries and vice versa.[45]

The pharmaceutical industry has been and is currently regarded as an excellent example of an industry where science and technology's R&D 'push' and market 'pull' factors are considered to be the main driving forces for (technological) innovation.[46] In the last two decades, however, scholars such as Alastair Matheson and Jeremy Greene have pinpointed the integration of R&D and marketing that reflects the integration of scientific claims and commercial

[43] Pieters 2004, 6.

[44] For the rise of the ethical pharmaceutical industry, see Liebenau 1987, Swann 1988, Church and Tansey 2007, Wimmer 1994, Slinn 1995, and Huisman 1999, 443–78.

[45] Cunningham and Williams 1992, Liebenau, Higby and Stroud 1990 and Burhop 2008. According to Robert Fox and Anna Guagnini, one important development in research concepts and practices in industrial Europe during the nineteenth century was that "the increasingly powerful ideals of laboratory-based pedagogy and research affected and were affected by the unprecedented emphasis on the industrial applications of science." Fox and Guagnini 1999, 42.

[46] Achilladelis and Antonakis 2001, 539 and Quirke 2009, 123. See also Chandler 2005.

positioning, which in turn generates knowledge with implicit commercial functionality.[47] Others have argued that during the last two decades, the process of spearheading marketing as the prime driving force in the pharmaceutical industry has resulted in a corporate colonization of pharmaceutical science and public health, at least in the United States.[48] For example, the global vaccination program to fight a possible H1N1 "swine flu" influenza pandemic using Tamiflu and other anti-flu medicines by the World Health Organization (WHO) in 2009, has raised questions about whether commercial interests were prevailing over scientific and public health interests.[49] This thesis will argue that these developments in the pharmaceutical industry are not historical novelties; rather they are an intrinsic part of the industry's development since the early twentieth century.

I will show that the Dutch cinchona-quinine enterprise, a pharmaceutical consortium of cinchona producers and quinine manufacturers, was able to capitalise on one of the first international public health campaigns to fight malaria led by WHO's forerunner, the League of Nations, thereby promoting the sale of quinine, an antimalarial medicine.[50] In this process, commercial interests prevailed over scientific interests, thus blocking the circulation of knowledge regarding the scientific cultivation of cinchona in favour of monopolistic (commercial) interests. Whereas many studies have addressed numerous forms of knowledge circulation (kinds of knowledge, and how, where, when, for whom), the issue of blocking or deliberately engineering knowledge circulation as a result of commercial or other interests remains largely understudied.[51] I will show how science, industry and trade were increasingly interwoven within the Dutch transoceanic cinchona-quinine consortium, thus inducing a state of ignorance for the sake of business interests in the Dutch empire. So, this thesis will contribute to our understanding of how the pharmaceutical industry became an important actor in the development

[47] Matheson 2008, Jeremy 2004 and Greene 2009.

[48] Applbaum 2010 and Boggs 2005. See also King 2002 and Abraham 2002.

[49] Zumach 2012. See also Abraham 2002.

[50] According to Nicolas King, the first international congresses and supra-national organizations were established to 'address international health' during the second half of the nineteenth and early twentieth centuries. King 2002, 764-765.

[51] A major exception is the expanding scholarship in the field of agnotology, the production and maintenance of ignorance or non-circulation of knowledge at the intersection of science and industry, and specifically the scholarship regarding the tobacco industry in the United States. See, Proctor 2008.

of modern health care during the first half of the twentieth century, moving on a hybrid medical market where both health and commercial interests were at stake.[52]

Furthermore, an important contribution of this thesis lies in the unique economic character of two closely interlinked products—cinchona bark (used to manufacture quinine) and quinine—in comparison to other colonial export commodities such as sugarcane, tea and coffee. According to Andrew Goss, cinchona bark differed from other tropical agricultural products in two important ways: 1) it was a far more costly and technologically challenging process to turn cinchona into a global commodity and 2) there was a relatively limited global demand for quinine, which was merely used as an anti-malarial at the time.[53] Thus, the balance between the supply of the raw material and the demand of the final product was quite delicate. Overproduction and subsequent price erosion were always lurking. In order to control the delicately balanced product chain, the German quinine manufacturers formed the first global pharmaceutical cartel in the 1890s.[54] At the same time, in response to growing consumer demands for pure and trustworthy medicines, the German pharmaceutical industry focused attention on the processes of purification and standardization throughout the product chain. Laboratory research became an integral part standardizing the industrial production process and enhancing the quality standards of the final and semi-finished products, and also for the raw material. I will show how this industrial laboratory revolution affected colonial agro-industrialism and resulted in a growing interconnection between the production and exportation of a high-quality cinchona bark from the Netherlands Indies with the production and distribution of high-quality quinine medicine by the European pharmaceutical industry.[55]

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[52] Huisman and Vos 1995, 5. According to historian and physician Jeremy Greene: "As individual pharmaceutical agents encourage action in the spheres of clinical research, clinical practice, and medical marketing, they bring the economics of medical knowledge and the economies of hard currency into close apposition." Greene 2007, 233.

[53] Goss 2014, 9.

[54] By the turn of the twentieth century, the quinine cartel was joined by other pharmaceutical cartels such as the cocaine cartel, the codeine cartel and the iodine cartel. All these cartels were initiated and led by the same German pharmaceutical companies, such as E. Merck, C.F. Boehringer & Söhne and Knoll & Co., who in 1907 formed the 'Pharmazeutische Interessengemeinschaft.' Burkert 1990.

[55] Cunningham and Williams 1992.

Cinchona and quinine historiography

The historical trajectories of cinchona and quinine have been studied from multiple historical and scientific angles, foremost from a twofold perspective. First, quinine has often been portrayed as a 'tool of empire' in the European colonial expansion of the nineteenth century. Especially, in relation to the British imperial empire, several studies have addressed the imperial implications of cinchona and quinine, not only in the scramble for Africa, but also in the consolidation of British rule in India. Second, cinchona and quinine have been studied in relation to the botanic expeditions of Clements Markham and Robert Spruce.[56] Third, cinchona and quinine have been studied extensively from a scientific medical-health perspective regarding the development of malaria and the fight against this infectious disease. In these studies, emphasis is placed on quinine as a medical and social agent and its role in the growing development of medical science by the nineteenth and early twentieth centuries.[57] The historical trajectories of the development, production and distribution of cinchona and quinine, however, are only touched upon lightly in these studies. My thesis contributes significantly to this historiography in that it offers a new understanding of an understudied aspect of the quinine-malaria historical narrative, namely the agro-industrial production and distribution of cinchona and quinine. In addition, my thesis makes a historical story of the foremost Dutch protagonists and hence exploits archives not accessible to most historians outside the Netherlands.

In this regard, this thesis analyses an in-depth 'forgotten' chapter in the history of pharmacy in the Netherlands. In the various existing studies on the development of the discipline of pharmacy and pharmaceutical production and distribution in the Netherlands, surprisingly little attention has been paid to the development of the cinchona and quinine businesses in the Netherlands Indies and Netherlands during the period under investigation in this thesis.[58] An exception is Margaret Algera-van der Schaaf's thesis in which the life of the pharmacist and 'kinoloog' (cinchona specialist) Johan Eliza de Vrij is described. However, Algera-Van der Schaaf's analysis is strongly focussed on the life of De Vrij and does not

[56] Duran-Reynals 1946, Brockway 1979, Headrick 1981, Honingsbaum 2001, Barton 2007, Veale 2010, Rocco 2003 and Deb Roy 2013.

[57] Garrison 1978, Maehle 1999, Webb 2009 and Kaufman and Rúvela 2005.

[58] Wittop Koning 1986, Bierman 1988, Vos, Wolters and Van der Schuit 1999 and Algera-van der Schaaf 2000.

detail the development of the cinchona and quinine enterprise within the realm of the Dutch colonial empire.[59]

Last, but not least, I would like to mention in more detail the work published by Andrew Goss on the Dutch cinchona and quinine enterprise.[60] In his book, *The Floracrats*, Goss dedicates an entire chapter ('Quinine science') to the development of the cinchona cultivation in the Netherlands Indies. Here, Goss describes cinchona cultivation as the 'bedrock' of Dutch colonial agriculture, specifically the export plantation economy, and shows how state-sponsored scientists, like Franz Junghuhn and Karel Wessel van Gorkum, contributed as *Floracrats* (state experts on nature) to the development of the Netherlands Indies colonial state. Although Goss clearly shows how the cinchona cultivation developed during the second half of the nineteenth century, his analysis is strongly focused on how science and henceforth cinchona cultivation was incorporated to strengthen Dutch colonialism. A similar line of argument is followed by Goss in his article, "Building the world's supply of quinine: Dutch colonialism and the origins of a global pharmaceutical industry," in which he describes the development of cinchona cultivation in the Netherlands Indies during the late nineteenth and first decades of the twentieth centuries. Although the basic sequence of historical events is similar to my narrative, my presentation of particularities is distinct and based on a larger corpus of archival material.[61] Goss's approach in this work was to write a "global history of quinine," using an analysis of Dutch colonialism as a framework.

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[59] Algera-van der Schaaf 1994.

[60] Goss 2011 and Goss 2014.

[61] Whereas Goss primarily uses Dutch colonial administrative archives, I have used additional colonial source material, such as the annual reports of the Government Cinchona Estate. These first-hand and detailed reports of the overseas Colonial Cinchona enterprise offer a new perspective on how scientists working at the Estate interacted with planters, European scientists and state officials. They also describe how the scientists implemented botanical and chemical practices on the estate and reacted to new scientific and technological developments in the European pharmaceutical industry. In addition, I have extensively used the reports and correspondences regarding the *Kinabureau* in the archive of the Nederlandsche Handel-Maatschappij (NHM). This large corpus provides ample insight in how scientists, cinchona producers and quinine manufacturers, both in the Netherlands and Netherlands Indies, closely interacted within the realms of the Cinchona Bureau during the 1920s and 1930s. Goss 2014, 10.

The framework of analysis in this thesis is the circulation of knowledge and interaction between the domains of science, industry, commerce and the (colonial) state. The objective of this thesis is thus to illustrate how across the Dutch colonial empire of the late nineteenth and first half of the twentieth centuries (colonial state-sponsored) scientists, planters and traders, industrialists and state officials created specific cinchona and quinine networks that, in turn, were able to dominate and control the international (pharmaceutical) cinchona and quinine markets.

The structure of this thesis

In 1945, the former director of the Government Cinchona Estate, the pharmacist Mathieu Kerbosch, recalled, "After all, [the cinchona cultivation] is not only the largest culture of medicinal plants in the world, but she also produces an important and for humanity indispensable medicine of which she practically possesses the monopoly. Due to this monopoly position and the meaning of her product, as an unequalled medicine for the eradication of malaria, the cinchona cultivation takes in a very special place."[62] This thesis is about this special cultivation and how it developed from a personal project of prestige into a worldwide leading enterprise involving a diverse group of scientists (botanists, pharmacists, and chemists), planters and traders, industrialists and state officials across the Dutch empire during the course of almost one century.

The first chapter will show how during the second half of the nineteenth century, a high-quality and commercial Dutch cinchona cultivation program was established through the interplay of state-sponsored colonial scientists, the developments in the pharmaceutical industry in Europe (foremost Germany) and the colonial government's objectives of realizing a profitable and exploitable export crop. Alongside the development of the Dutch cinchona cultivation, this chapter will also describe the establishment and development of cinchona cultivation in the British Empire. In addition to the Dutch, the British also succeeded in transferring, introducing and acclimatizing cinchona in their Asian colonies of British India and Ceylon (Sri Lanka) during the late 1850s. Until the 1880s, Ceylon was the largest producer of cinchona bark for the European

[62] M. Kerbosch, *Het Kina-Monopolie van Nederlandsch-Indië* (Nota voor het Ministerie van Overzeese gebiedsdelen, 1945), no. 106, Kerbosch-collection, KITLV, Leiden.

pharmaceutical industry. I am fully aware of the fundamental differences in the nature of the historical sources used for describing the British case (primarily secondary literature) and the Dutch case (foremost primary material). However, I would like to emphasize the need for a comparative approach to achieve a far more fine-grained analysis of how science, industry and government interacted within the Dutch cinchona cultivation program and in particular, during the second half of the nineteenth century.

In the second chapter, I show how the Dutch cinchona producers and quinine manufacturers came to dominate the international cartel that controlled the worldwide production and distribution of quinine (an antimalarial), quinine sulphate (a semi-finished product) and cinchona (the raw material) in the period between roughly 1880 and 1920. Since the 1870s, the German pharmaceutical industry had dominated international trade in cinchona, quinine sulphate and quinine. I argue that the internal shift of *power* was largely the result of the following three factors: increasing laboratory control of cinchona bark, quinine sulphate and quinine medicines; the establishment and maintenance of a transoceanic network of cinchona producers, quinine manufacturers, (colonial) scientists and state officials across the Dutch Empire; and Germany's economic isolation during the First World War. As a result, a Dutch network of cinchona producers and quinine industrialists, strongly supported by the Netherlands Indies colonial state, was able to take control over the entire product chain from raw material (cinchona bark) to final product (quinine medicines). Although the focus in this chapter is on the European actors in this transnational state-industry project, I am fully aware of the colonial context of the late nineteenth century and early twentieth centuries' plantation economy. Therefore, a brief characterization of the relationships between the Dutch and the native population of the Netherlands Indies is included to explore how the Dutch exploitation of local resources was shaped by these relationships.

In the third chapter of this thesis, I show how the internal shift of power in the international quinine cartel developed vis á vis the establishment of a Dutch transoceanic cinchona-quinine enterprise. In the two decades between the two world wars, this transoceanic enterprise, characterized as a Dutch consortium of cinchona producers and quinine manufacturers, strengthened and consolidated its dominance over the international cinchona and quinine markets. I argue that during this period, the Dutch dominated Cinchona Bureau became the decision-making centre of the international quinine cartel that controlled the production

and trade of an essential medicine. In this way, the Dutch consortium not only controlled the worldwide production and distribution of cinchona and quinine, but was also able to capitalise on the League of Nations' international public health campaigns the fight malaria and to promote the sales of quinine.

The first three chapters of this thesis thus illustrate how the Dutch succeeded in controlling the production of cinchona bark and hence build a Dutch transoceanic cinchona-quinine enterprise. The last chapter shows how the post-Second World War globalization of the international market for raw materials and final products and the decolonization of Indonesia during the 1950s and early 1960s challenged the Dutch control of the cinchona and quinine markets. In this way, this last chapter can be regarded as the close of a historical trajectory of more than one century in which a dynamic process of interaction and circulation of knowledge between science, commerce, industry and the (colonial) state resulted in a Dutch dominated cartel that controlled the cinchona and quinine markets. In this chapter, I argue that this process can be regarded as the reconfiguration of a colonial agro-industrial system to an agro-industrial system.

Chapter 1. Science in the service of colonial agro-industrialism

The case of cinchona cultivation in the Dutch and British East Indies (1852-1900)[1]

The isolation of pure quinine from cinchona bark, in 1820, opened new possibilities for the mass-production and consumption of a popular medicine that was suitable for the treatment of intermittent (malarial) fevers and other diseases. As the nineteenth century European empires expanded in Africa and Asia, control of tropical diseases such as malaria was seen as crucial. Consequently, quinine and cinchona became a pivotal tool of British, French, German and Dutch empire-builders.[2] Several European natural scientists urged their governments to transfer cinchona seeds and plants from South America to their Asian and African colonies. They argued that the destructive production and export methods of the South American *cascarilleros* (Andean bark collectors) were threatening the flow of sufficient cinchona bark to satisfy the exponentially growing demand for the malarial medicine quinine.[3] The message was not lost on the British and the Dutch who put forward humanitarian ('preserve the cinchona for future generations') economic (profitable cash crop) and military (establishment of colonial rule) motives to secure the flow of sufficient cinchona for the production of the anti-malarial quinine.[4]

The historical trajectories of cinchona in the Dutch and British East Indies during the second half of the nineteenth century are closely related to the rise of chemistry and the introduction of laboratory sciences. Botanists, pharmacists and chemists began to chemically analyse the natural world and develop new insights in plant breeding and cultivation techniques.[5] The transformation of botanical research also changed the roles of the botanical gardens across the European colonial empires. From a collecting centre of the natural riches of the eighteenth

[1] A shortened version of this chapter was published in *Studies in History and Philosophy of Biological and Biomedical Sciences*. Roersch van der Hoogte and Pieters 2014.

[2] Brockway 1979 and Headrick 1981.

[3] Crawford 2009, Headrick 1988, Brockway 1979, Rocco 2003 and Honingsbaum 2000.

[4] Goss 2011, 34.

[5] Osborne 2000 and Drayton 2000.

century expanding empires, the botanical garden gradually became a state sponsored centre for the experimentation and testing of profitable and exploitable tropical cash crops.[6] In the Netherlands Indies, the Botanical Garden at Buitenzorg (today Bogor) had earned by the start of the twentieth century a reputation as a renowned international centre for research in tropical plants and cultivation, characterized by researchers as "the finest institution in the tropics for the aid of agriculture."[7] By the end of Melchior Treub's directorship (1880–1909) the Botanical Garden included a complex of field stations and chemical–botanical laboratories that aimed to improve and exploit colonial agriculture for monetary profit. These also included privately owned field stations financed by several agricultural syndicates (for example, those for coffee, rubber, and cacao) into the scientifically influential sphere of the Botanical Garden.[8] Botanists, chemists, and pharmacists worked at the garden with local and exotic plants and exchanged knowledge with private and government-owned plantations, as well as with international scholars and institutions, making it an important site for the production and circulation of agricultural knowledge and expertise in addition to specimens. In this chapter, I will show how the Government Cinchona Estate, established in 1852, can be regarded as an forerunner of Treub's botanical garden, incorporating laboratory science in the commercialization of an agricultural export crop.

The developments of the Government Cinchona Estate and Botanical Garden as agricultural field stations by the second half of nineteenth century were strongly influenced by the increasing role of the (colonial) state in the expansion of the European colonial empires. In the Netherlands Indies, the Botanical Garden at Buitenzorg ('s Lands Plantentuin), for example, was established in 1817 to collect, describe and experiment with the natural resources of the archipelago for possible profitable exploitation.[9] However, it was only during and after the gradual introduction of the large-scale private colonial-plantation economy of the 1850s

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[6] Drayton 2000 and Goss 2011.

[7] Cited in Willis 1901. See also Goss 2011, chapter 3.

[8] Goss 2011, 80 and Wille 2015, 330-334. The only syndicate that refused to join Treub's network was the syndicate of sugar planters; see Schoor 1994, 145–61. Treub later created facilities that were specifically aimed at food agriculture and increasing food supplies, however, not with the same profit-seeking perspective as described here. See Moon 2007, and Goss 2011.

[9] Maat 2001, 46-48 and Weber 2012, chapter IV.

and 1860s that the application of laboratory science (a combination of chemical and botanical sciences) became of much interest.[10] According to Andrew Goss, liberal politicians turned to their scientists for answers how to transform the coercive Cultivation System in a more liberal system without losing the benefits, the so-called *batig slot*, of the Netherlands Indies for the Dutch state.[11]

One of these was Gerrit Jan Mulder, who since the 1830s was advisor to the Ministry of Colonies. As a strong advocate of applying chemistry in the improvement of agriculture, Mulder urged the government to "quickly make Java cultivate everything which can be produced profitably" with the help of chemical science.[12] Just like the professor of botany Friedrich Miquel (1811-1871), Mulder emphasized the important role of the Botanical Garden at Buitenzorg as a central (scientific) institution within the new framework of colonial agriculture in the Netherlands Indies. As a result, several chemical laboratories were established in the Netherlands Indies during the 1850s. One of these was the chemical-agricultural laboratory at the Botanical Garden, established by one of Mulder's students, P. F. H. Fromberg in 1851. The laboratory, however, did not survive Fromberg's death in 1858, and it took almost thirty years before a similar laboratory was re-established at Buitenzorg.[13] In that same year, as I will show, a chemical laboratory was established in the city of Bandung to aid the just established government cinchona cultivation program. This program marked a new period in agricultural cultivation in which chemistry became a tool for colonial agriculture, specifically for improving existing large-scale colonial plantations. As I will show, the cinchona cultivation program served as the "bedrock of the modern

[10] Maat 2001, Moon 2007 and Goss 2011.

[11] Goss 2011, 34. See also, Fasseur 1991, 35 and Doel 1994. Wille's shows in his dissertation how (colonial) scientists like Melchior Treub were remarkable lobbyist for securing funds for their research. Wille 2015.

[12] Snelders 1990 and Theunissen 2000, 80-97. Quoted in Goss 2011, 34 and Snelders 1990, 257.

[13] Although the laboratory did not survive Fromberg's death in 1858, the idea of jointly applying chemistry and botany remained. When botanist R. H. C. C. Scheffer (1844–1880) was appointed director of the Botanical Garden in 1868, experimental botany became the central theme for the scientists working there. Scheffer extended the garden's collection by re-establishing contact with other gardens and scientific centres and exchanging plants and knowledge. Maat 2011, 40–41 and Goss 2011, 57.

colonial science" in the Netherlands Indies, applying the laboratory in the creation of new knowledge and hence a new cinchona species.[14]

In the British colonial empire by the late nineteenth century, the Royal Botanical Gardens of Kew had become the central scientific institution within the British Empire and part of what Richard Drayton has called "the global triumph of the idea of bureaucratic government as the key to social efficiency."[15] Central to the development of Kew Gardens during the nineteenth century was the idea of colonial science as the "core culture of imperialism."[16] Through the application of the sciences (foremost the life sciences: botany, geology and geography), British possessions could be made accessible, controllable and exploitable and profitable. This was especially the case for India, whose potential was recognised as an agricultural country.[17] The circulation of botanical knowledge was central in the collection of and experimentation with new species to improve the agricultural output of Britain's most important colony.[18] Exemplary were the developments of the Indian tea and indigo industries. Both crops were introduced and acclimatized by the early nineteenth century in the Calcutta Botanical Garden and afterwards commercialized, thus developing into two of the most important export crops of British India and Ceylon during the nineteenth century.[19] Science in general and (economic) botany in particular (stressed by father and son Hooker as the cornerstone of Kew's imperial network) were central to the imperial ideology of the British Empire, making Kew Gardens a central agency of what Roy Macleod has defined as the 'Creed of Science'.[20] As I will argue in this chapter, the cinchona cultivation enterprise was regarded as an important factor in Kew Gardens' control over the network of colonial gardens during the 1880s and 1890s and as "a symbol of the benevolence of both science and empire."[21] In contrast, the Dutch colonial

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[14] Goss 2011. See also Wille 2015 regarding the role of the laboratory and the creation of new knowledge in close relationship with colonial practice.

[15] Drayton 2000, 221.

[16] Kumar 1995, 15.

[17] Kumar 1990, 54 and Kumar 1995, 40-42.

[18] Brockway 1979.

[19] Sharma2006 and Kumar 2007.

[20] MacLeod 2000b.

[21] Drayton 2000, 211 and Philip 1999, 134-135.

objective was to make the Netherlands Indies a profitable colony (*Wingewest*) for the motherland, with science in the service of economic gain.

This chapter is arranged as follows. The first part will discuss how the transfer, acclimatization and experimentation of cinchona evolved during the 1850s and 1860s, and, how a similar point of departure in the Dutch and British colonies resulted in disparate outcomes. The second part then discusses how professionalization and networks of knowledge circulation played a role in further shaping the cinchona cultivation programs in the Netherlands Indies and British India by the 1870s. In the third part, the focus is on how the Dutch and British cinchona cultivation enterprises were shaped by market and industry developments during the last two decades of the 19th century.

Cinchona transfer, acclimatization and experimentation in the Dutch and British colonies

In the 1850s and 1860s, Dutch and British scientists (botanists and chemists) thus set out to identify the 'right' cinchona species for the job of acclimatizing cinchona in British India and Ceylon and the Netherlands Indies.[22] Between the late eighteenth and mid-nineteenth centuries, several botanical expeditions resulted in a growing knowledge production on the geographical distribution of cinchona and the identification of many cinchona species and variations. The problem of classification, however, remained. An important reason was the range of the variation in species and a broad variety of physical characteristics of individual trees including: appearance, taste, smell and texture.[23] Alexander von Humboldt, who had described the tree in Ecuador by the turn of the nineteenth century, for example, reported on the leaves saying, "I know of no tree that varies more in the form of its leaves than the cinchona."[24] Another reason for the classification problem was hybridization. Through cross-pollination between multiple cinchona species, it became more difficult to pinpoint the various species and especially the varieties of cinchona.[25] The complexity of the taxonomy of the cinchona genus, however, resulted in two different ways of

[22] Kerbosch 1931b, 319 and Markham 1880, preface.
[23] Crawford 2009, 20.
[24] Cited in Suppan 1931, 65.
[25] Kerbosch 1931b, 328.

integrating scientific knowledge and governmental objectives in the cultivation of cinchona in the Dutch and British colonial empires.[26]

Dutch acclimatization efforts

The Dutch were the first to successfully transfer cinchona seeds and plants to their Asian colony of the Netherlands Indies. In 1851, the Dutch Minister of Colonies C.F. Pahud decided to send the German botanist Justus Karl Hasskarl to southern Peru to collect as many cinchona seeds and plants as possible.[27] Barely a year later, the first cinchona plant was introduced in the mountain garden of Cibodas near the Botanical Garden in Buitenzorg on Java. The rather quick localisation, identification and transfer depended to a large extent on the botanical exchange between Friederich Miquel, professor of botany in Utrecht, and the French explorer and botanist, H.A. Weddell.[28] Weddell was the authority on cinchona species by the mid-nineteenth century and the first to record the origin and the natural history of all commercial barks since the seventeenth century.[29] Weddell's 1849 publication "*Histoire Naturelle des Quinquinas*" provided the Dutch and British expeditions of the 1850s with important botanical knowledge in their quest for the best commercial cinchona species. In this work Weddell described 21 species which were already known and added several new species which he had encountered during his two year expedition (1847-1848) in southern Peru and northern Bolivia.[30]

The first steps of introducing and acclimatizing the cinchona were taken by Hasskarl, who upon arrival on Java with a collection of plants (only 75 plants survived the crossing of the Pacific Ocean), in 1854, was appointed the first director of the newly created Government Cinchona Estate (GCE).[31] Applying his own experiences in Peru and the botanical knowledge acquired by botanists like

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[26] In 1998 Lennart Andersson wrote a revision of the genus Cinchona, considering "more than 330 names." Andersson 1998, 2.

[27] Vriese 1855. In this work De Vries provides a full account of Hasskarl's Peruvian expedition.

[28] Gorkum 1945, 184 and Minister of Colonies to Governor-General 10 November 1851, No. 6, Item 138 Archief Ministerie van Koloniën 1850-1900, Nationaal Archief, Den Haag.

[29] Algera 1994, 51.

[30] Algera 1994, 51 and Suppan 1931, 72-73. A description regarding Weddell's expedition can be found in Suppan 1931, 67-71.

[31] On Hasskarl's journey see among others Vriese 1855 and Gorkum 1886, 27-30.

Weddell, Hasskarl set out to identify suitable locations for the acclimatisation of the cinchona tree in close cooperation with the horticulturist and director of the Botanical Garden J.E. Teysmann.[32] During these first years of the program, emphasis was thus placed on the acclimatisation of the plants to their new habitat and experimentation to determine the best altitude, soil and water supply.[33] In 1856, Hasskarl was succeeded by Franz Wilhelm Junghuhn. Under the directorship of Junghuhn, the Dutch cinchona cultivation enterprise expanded rapidly, and by 1862 more than one million trees of the species *pahudiana* were standing in the ground.[34] This, however, did not result in a profitable cultivation and by September 1862, Junghuhn was ordered by the Dutch government to stop the cultivation of the *pahudiana* and start experimentation with other species. This was after an entire *pahudiana* tree had been botanically and chemically analysed by Professor Miquel and Mulder in the Netherlands, who concluded that this species contained almost no quinine alkaloid and was determined to be the "wrong species."[35] What had happened and why did Junghuhn fail?

An expert on Javanese geography and botany, Junghuhn's decision to move the location of the GCE away from Cibodas was in retrospect well estimated. He regarded the volcanic and fertile soil of the southern slopes of the Malabar Mountains in the Prianger region (see illustration 1), as the "most suitable place for the cinchona cultivation," establishing an infrastructure of several plantations that consisted of multiple gardens at varying altitudes with distinct soils connected by a system of paths and roads. [36] However, the problem was Junghuhn's inability to cooperate. He regarded the cinchona project as his own individual project and the culmination of his career as a 'Humboldtian' naturalist and explorer of Java's nature. Confident of his own capabilities as a scientist, Junghuhn saw no need for cooperation and isolated the GCE from external

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[32] Gorkum 1886, 27-30.

[33] Gorkum 1886, 27-30.

[34] Gorkum 1886, 29.

[35] Gorkum 1886, 44-46 and Algera 1994, 65-67. In a dispatch dated 23 of April 1862 the Minister of Colonies wrote to the Governor General: "put a check to the wrong direction the cinchona cultivation on Java and stop the multiplication of the Cinchona Pahudiana." Minister of Colonies to Governor-General, 23 April 1862, No. 20, Item 1173, Archief Ministerie van Koloniën 1850-1900, Nationaal Archief, Den Haag.

[36] Citation in Junghuhn 1858. Junghuhn 1863 and Gorkum 1886, 29.

influences.[37] By moving the GCE away from the Botanical Garden at Buitenzorg (see illustration 2), the colonies' scientific centre, Junghuhn was able to debar the influence of other colonial scientists, like the director of the Botanical Garden, Teysmann, and in his wake, scientists like Gerrit Jan Mulder and Miquel. The result was a GCE hermetically sealed from outside influence (Junghuhn' permission was required to enter the GCE), and nicknamed "the secret cultivation."[38]

Junghuhn's control of the developments of the GCE and his suspicion about external meddling of other scientists is well illustrated by the appointment of a chemist specifically for the GCE. In line with the growing importance of chemical research for determining the value of cinchona and its alkaloids, in 1855, the Dutch government asked Mulder to send a chemist to the Netherlands Indies to work on the recently established GCE. Mulder recommended a student of his, the young pharmacist Karel Wessel van Gorkum (1835-1910). Junghuhn, however, managed to have the pharmacist Johan Eliza de Vrij (1856-1861) appointed as chemist of the GCE in 1858.[39] In the first year, De Vrij analysed leaves, twigs and roots of dead trees for alkaloid content and specifically quinine content in a specially built laboratory in the city of Bandung, not far from the GCE.[40] He concluded that of the various species in the GCE, specimens of the species *calisaya* contained the most quinine.[41] Junghuhn, however, ignored De Vrij's laboratory work and convinced of his own expertise he continued the cultivation of the species *pahudiana* instead. This resulted in a growing separation of understanding between the two men. More importantly, Junghuhn neglected new scientific (laboratory sciences) and industrial (product standardization) developments regarding cinchona and quinine.[42]

The initial success of acclimatizing the cinchona in the Netherlands Indies was quickly overshadowed by Junghuhn's failure to produce cinchona bark with a sufficient high market value. Junghuhn's directorship resulted in a questioning of the GCE's position as field station for cinchona cultivation by Dutch scientists and

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[37] Junghuhn 1858 and Goss 2011, 39-40.
[38] Gorkum 1886, 25.
[39] Goss 2011, 38 and Snelders 1990, 260.
[40] Kerbosch 1931b, 321.
[41] Algera 1994, 63.
[42] Algera 1994, 66-67.

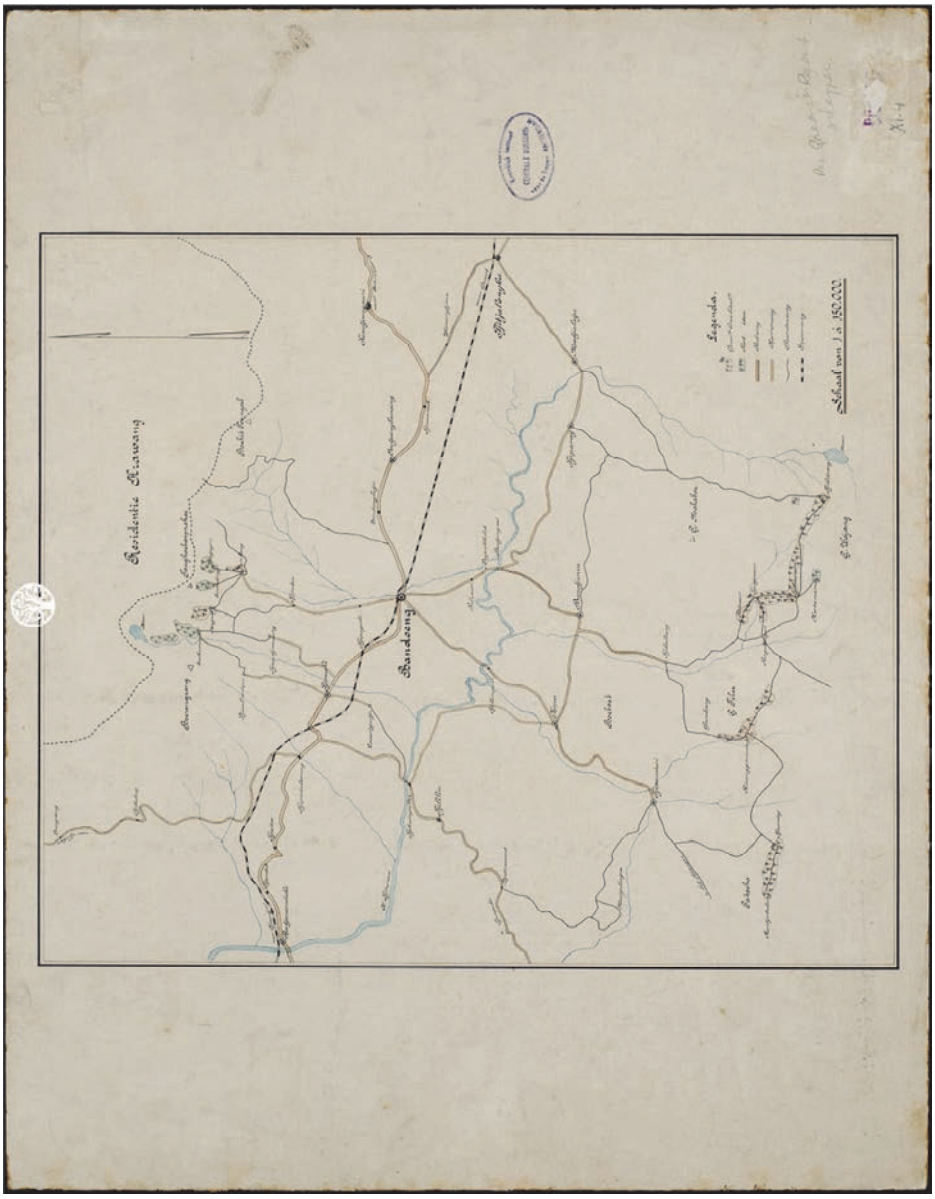
state-officials alike in the Netherlands.[43] This was stressed even more by the success of the British, who by the mid-1860s had succeeded in transferring, acclimatizing and exporting cinchona from British India. In order to have a profitable cinchona cultivation, new forms of cooperation between science, industry and government had to be established.

Table 1: Dutch scientists involved with cinchona

Name	Position	Discipline	Period involved
Gerrit-Jan Mulder (1802-1880)	Professor of Chemistry, Utrecht University	Chemist	ca. 1830-1860s
Friedrich Miquel (1811-1871)	Professor of Botany, Utrecht University and Director National Herbarium	Botanist	ca. 1846-1860s
Karl Justus Hasskarl (1811-1894)	1st Director of the GCE	Botanist	1852-1856
Wilhelm Junghuhn (1809-1864)	2nd Director of the GCE	Botanist/ Naturalist	1854-1864
Johan Eliza de Vrij (1813-1898)	Chemist at the GCE and Quinologist	Pharmacist	1857-1898
Karel Wessel van Gorkum (1835-1910)	3rd Director of the GCE	Pharmacist	1864-1875
Bernelot Moens (1837-1885)	Chemist/Quinologist and 4th Director of the GCE	Pharmacist	1864-1885
Richardus van Romunde (1846-1921)	5th Director of the GCE	Pharmacist	1882-1892
Pieter van Leersum (1854-1920)	6th Director of the GCE	Pharmacist	1884-1914

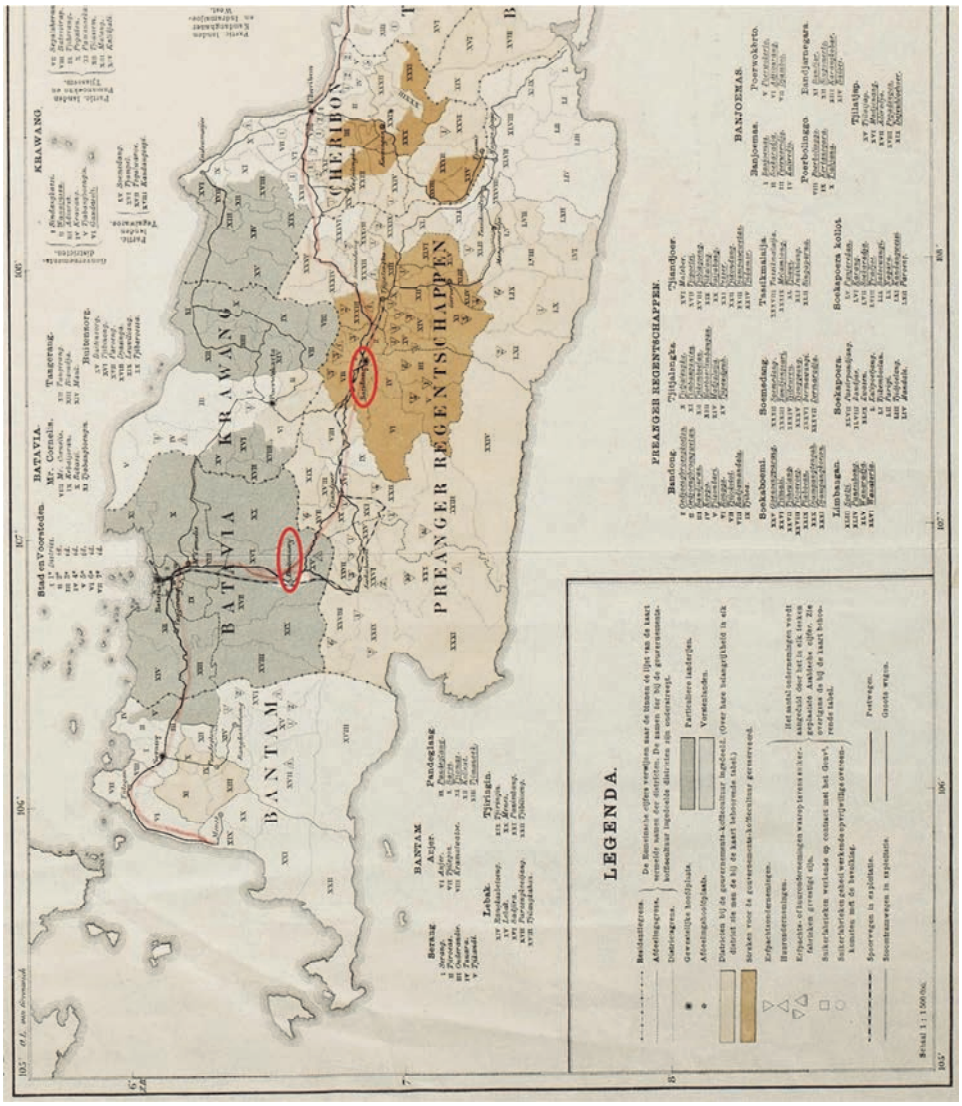
[43] Mulder and Miquel wrote an 88-page report concluding that Junghuhn's decision for the *pahudiana* was a failure and by mid-1863 the Parliament demanded a full investigation of what exactly had happened. Minister of Colonies to Governor-General, 23 April 1862, No. 20, Item 1173, Archief Ministerie van Koloniën 1850-1900, Nationaal Archief, Den Haag and *Handelingen van de Beide Kamers der Staten-Generaal: 79ste zitting 1862-1863*, pp. 890-892. See also Goss 2011, 45.

Illustration 1: The Government Cinchona Estate, north and south of Bandung in 1881.[44]



[44] The Royal Tropical Institute Amsterdam, colonial maps collection, Colonial Collection (KIT), Leiden University Library.

Illustration 2: West-Java in colonial time with emphasis on the cities of Buitenzorg and Bandung.[45]



[45] The Royal Tropical Institute Amsterdam, colonial maps collection, Colonial Collection (KIT), Leiden University Library.

British early success in acclimatization and commercialization

In 1859, the Indian Office clerk Clements Markham (1830-1916) was sent to South America to collect the necessary cinchona specimens for introduction in India to "provide an abundant supply of the febrifuge at so cheap rate".[46] Markham's appointment, however, was met with criticism because of his "ignorance of botany and science generally."[47] Sir William Hooker, director of Kew Gardens, therefore advised the Indian Office to recruit two botanists, Richard Spruce and Robert Cross, to join Markham in his search for cinchonas in the Andes. In 1861, Markham arrived in British India bringing hundreds of plants and seeds that Spruce, Cross and he had collected, which were sent to the experimental tree stations in Ootacamund in the Nilgiris Hills in southern India, Darjeeling in northern India and Perideniya on Ceylon. On Markham's recommendation, Ootacamund became the central station where the superintendent of the Ootacamund Botanical Garden William G. McIvor (1848-1876) had already made the necessary preparations.[48]

In April 1863, McIvor, claimed in a letter to Sir William Hooker, director of Kew Gardens, that the introduction of cinchona into India had been a success: "there can be no doubt that cinchona is secured to India."[49] The species *C. succirubra* and *C. officinalis* in particular were successfully acclimatized, which contained more quinine than the *pahudiana* (see Table 4), and became the nucleus of the cinchona plantations in British India and Ceylon.[50] At the same time, Thomas Anderson, superintendent of the Calcutta Botanical Garden (1861-1869) and Government Cinchona plantations in Bengal, also experimented with the *Pahudiana* and *Calisaya* species, which he had received from Junghuhn during his visit to Java in 1862.[51] Over the few next years, efforts to propagate a number of

[46] Muraleedharan 2005, 34. See also Markham 1880.

[47] According to John Lindley, professor of botany at University College in London. Cited in Mukherjee 1998, 86.

[48] Veale 2010, 150-153.

[49] Cited in Veale 2010, 160.

[50] Mukherjee 1998, 86.

[51] Wilson and Mirchandani 1939, 3 and Veale 2010, 153.

cinchona trees continued and by 1867 the first batch of cinchona was satisfactorily sold on the London market, stimulating the start of private cultivation.[52]

Table 2: British scientists involved with cinchona[53]

Name	Position	Discipline	Period involved
Clements Markham (1830-1916)	Officer of the Indian Office and head of the British cinchona mission	Geographer, explorer and writer	1859-1870s
William G. McIvor (1848-1876)	Superintendent Ootacamund Botanical Garden	Botanist	1861-1876
John Eliot Howard (1807-1883)	Quinologist and partner in Howard & Sons	Chemist	1827-1883
Sir William Hooker (1785-1865)	Director of the Royal Gardens Kew	Botanist	1859-1865
Sir Joseph Hooker (1817-1911)	Director of the Royal Gardens Kew	Botanist	1865-1885

Table 3: Cinchona species and their Asiatic introduction

Cinchona species	Introduction and geographical area
Cinchona pahudiana	1856 – Dutch East Indies 1861 – experiments British India
Cinchona succirubra ('Red Bark')	1861 – British India/Ceylon 1864 – Dutch East Indies
Cinchona officinalis ('Crown Bark')	1861 – British India/Ceylon 1864 – Dutch East Indies
Cinchona calisaya ('Yellow Bark')	1852 – Dutch East Indies Ca. 1860s – British India
Cinchona ledgeriana	1872 – Dutch East Indies Mid-1870s – British India/Ceylon

In contrary to Junghuhn's isolated GCE, the British colonial scientists McIvor and Anderson interacted closely with Kew Gardens in London. Situated at

[52] Veale 2010, 161-163 and Wilson and Mirchandani 1939, 5-6.

[53] See for short biographies Veale 2010, 313-333.

the centre of an imperial network of botanical gardens in the British Empire, Kew Gardens was the designated institution to guide the centralized process of cinchona cultivation, "the administrative focus of all stages of the project."[54]

Furthermore, from the start of the enterprise, bark samples from India were sent by Kew to the quinologist and quinine manufacturer John Eliot Howard (1807-1883) who conducted chemical analysis on the barks in his London laboratory.[55] Whereas the Dutch cinchona enterprise under the directorship of Junghuhn became the individual project of one stubborn colonial scientist, the British cinchona enterprise was directed and guided by Kew Royal Botanical Gardens in London and part of a larger scheme of aiding the Empire through botanical knowledge—economic botany.[56] Scientific knowledge, commerce and governmental objectives were thus more tightly connected in the British case; with the result that commercialization of the cinchona cultivation was realized much quicker.

Professionalization, autonomy and a crop innovation system versus the production of cheap febrifuge (1860s-1870s)

The early success of the British cinchona cultivation and the failure of Junghuhn to establish profitable cinchona cultivation resulted in two distinct trajectories for quinine and cinchona within the Dutch and British colonial contexts during the late 1860s and 1870s. The trajectories were influenced by new international debates on the pharmaceutical-medical use of cinchona alkaloids other than quinine, developments within the German pharmaceutical industry and how the cinchona enterprise was guided by government objectives. The Dutch, whose objective was to make the colony profitable, emphasized the constant scientific improvement of the cinchona cultivation in order to produce a high quality and profitable cinchona bark product with a high quinine content for the German pharmaceutical industry. Through the interplay between scientists, state-officials and industrialists, the Dutch were able to construct a cinchona cultivation program that would form the bedrock of an early 20th century colonial agricultural-

[54] Drayton 2000, 209.

[55] The many years of analyzing the barks from India resulted in the work *The Quinology of the East Indian Plantations* (1869-1876). See Veale 2010, 322-323.

[56] Drayton 2000, 206-211 and Brockway 1979, 103-139.

industrial system that differed significantly from the British system.[57] Meanwhile, the British cinchona enterprise became governed by the objective to secure abundant bark for the production of cheap febrifuges in order to supply the vast armies of colonial servants and military men. In both trajectories, as I will show, the employment of the laboratory as an instrument of control would gradually materialize.

Commerce, industry and pharmaceutical-medical debates on quinine and other alkaloids

After the French pharmacists Pelletier and Caventou isolated quinine, dozens of small-scale manufacturers were producing quinine by the 1820s. This included Pelletier and Caventou, but also German pharmacists like Friedrich Koch and Friederich Jobst, the British chemist J. Howard and the Dutch pharmacists Nieuwenhuys and d'Ailly.[58] By the mid-19th century German pharmaceutical companies like C.F. Boehringer & Sohne and Zimmer & Co. were focused on the production of quinine.[59] By the 1860s and 1870s, cinchona and quinine research was foremost conducted by chemists leading the German pharmaceutical industry, such as O. Hesse for Jobst and G. Kerner for Zimmer & Co.[60] The Germans worked to find better ways to extract the quinine from the bark and to analyse the quality of the various barks sold on the market. This was an example of how the laboratory became central in the production of (new) botanical and pharmaceutical knowledge.[61]

Triggered by the successful acclimatization of the species *succirubra* and *officinalis* in British India, new debates on the pharmaceutical-medical value of quinine and other cinchona alkaloids arose across various European laboratories. In addition to quinine, three other alkaloids were isolated during the early nineteenth century: cinchonine in 1811/1820, kinidine in 1833 and cinchonidine in 1848. These alkaloids were medically seen considered to be less important than quinine. However, the *succirubra* and *officinalis* species contained more of these

[57] The term 'bedrock' is from Goss 2011.
[58] Dethloff 1944, 19-20, Schulte-Sasse 1992, 39, Ziegler 2003, 59-64 and Groothoff 1925, 96.
[59] Buchler 1958, 86.
[60] Ziegler 2003, 92-110.
[61] Cunningham & Williams 1992, 8-9.

alkaloids than quinine did, which resulted in new chemical investigations about the medical usage of these alkaloids. Howard and De Vrij concluded by the mid-1860s that the therapeutic values of these other cinchona alkaloids, which they named 'quinetum,' were "almost as efficacious as quinine."[62] In the German pharmaceutical industry, chemists began experimenting with the extraction of the other cinchona alkaloids and compared them to the extraction of quinine.[63]

By the mid-1870s, these debates shifted once again. Despite positive assessments of the pharmacological properties of the non-quinine alkaloids by scientists like Howard and De Vrij, quinine remained the most preferred alkaloid for medical treatment. Two interrelated factors can be argued for this. First, the alternative cinchona alkaloid extracts like quinetum were extremely variable in composition and therapeutic effect. Doctors preferred to prescribe the pure quinine drug preparations.[64] Second, the German pharmaceutical industry, which by the 1870s had begun to grow into the most important and largest industry of its kind in Europe, was keen on creating in-house laboratories in order to standardize the alkaloid extracts and produce drug compounds of higher purity than their European competitors.[65] Hence, quinine was preferred to alternative cinchona febrifuges that were more difficult to purify and cinchona species containing the highest yielding of quinine and almost no other alkaloids were preferred by the (German) pharmaceutical industry.

Professionalization and reorganization—transnational circulation of knowledge

Junghuhn's death, in 1864, created new opportunities to reorganize the Dutch cinchona cultivation.[66] Stimulated by the British success and pressured by the Dutch government, Junghuhn's successor K.W. van Gorkum began the

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[62] De Vrij became one of the leading cinchona and quinine experts worldwide after returning to the Netherlands in 1863. Algera 1994, chapter 2.

[63] Ziegler 2003, 100-102.

[64] Algera 1994, 154, Ziegler 2003, 49-51 and Kerbosch (1931b), 321.

[65] Burhop 2008 and Wimmer 1994.

[66] Junghuhn resigned as director of the GCE in early 1864. However, before leaving to Europe, he died and was burried in Lembang (north of Bandoeng), next to one of the GCE plantations. Leersum 1945.

daunting task of establishing a profitable cinchona cultivation.[67] Learning from Junghuhn, Van Gorkum's directorship was characterized by openness and close collaboration with scientists, state-officials and planters; initiating the first steps in the commodification of colonial science. He exchanged knowledge with Mulder and Miquel in the Netherlands, exchanged seeds and plants with his British peers in India, involved the Botanical Garden of Buitenzorg and worked closely with the pharmacist Bernelot Moens. By the late 1860s, Moens was working in the laboratory of the military hospital of Weltevreden (a suburb of Batavia, now Jakarta).[68] This dynamic circulation of knowledge within an international network of peers enabled Van Gorkum to establish an autonomous GCE, which by 1869, had succeeded in sending the first bark consignments to Europe.[69] In contrast to Junghuhn, Van Gorkum was the prototype of a 'state-scientist', a professional whose primary objective and focus was the maintenance and evolution of the government-led GCE and its cinchona program.[70]

With the export of bark in 1869, Van Gorkum had successfully reorganized the GCE. He had arranged the plantations in multiple gardens so that each one represented a specific stage in the trees' growth. In this way, Van Gorkum was able to investigate several species simultaneously and determine how the quinine content differed according to soil, weather and altitude.[71] The next step was quality improvement of the cultivation. In the 1869 annual report, Van Gorkum stressed that the chemical analysis of the exported barks had shown significant alkaloid content, but that the "pure quinine content was rather variable" and "our knowledge regarding the forming of natural alkaloids remains poor and inadequate."[72] Like his professor Mulder, Van Gorkum was convinced of the

[67] According to one member of the Dutch Parliament in 1863: "We must prevent the cinchona cultivation, which has already cost so much trouble, efforts, and fortune, from being sacrificed to personal ambition and stubbornness to preconceived ideas." *Handelingen van de Beide Kamers der Staten-Generaal: 79ste zitting 1862-1863*, 890-892. Also cited in Goss 2011, 45.

[68] Verslag der Gouvernements Kina-onderneming (1864-1869).

[69] Gorkum 1886, 61.

[70] Kumar 1995, 15, Goss 2011, chapter 2 and Schoor 2012, 219.

[71] *Verslag der Gouvernements Kina-onderneming* (1864-1869), Item L 2050, Colonial Collection (KIT), Leiden University Library.

[72] *Verslag Government Kina-onderneming 1869*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

application of chemistry in the improvement of agriculture, and specifically tropical agriculture.[73] In the case of cinchona, he therefore stated: "for a more adequate assessment of the cinchona bark, chemical analysis is indispensable."[74] Since De Vrij had left the GCE in 1863, chemical analyses on the barks were conducted in the laboratory of the military hospital of Weltevreden. Van Gorkum, however, requested that a fulltime chemist to be appointed at the GCE and in 1872 Moens was appointed chemist.

Like Van Gorkum, Moens was also a student of Mulder, arriving two years after Van Gorkum in the Netherlands Indies (1858). After eight years at the chemical laboratory of Batavia investigating minerals and soil types, Moens subsequently worked between 1866 and 1872 at the military hospital of Weltevreden, where he mainly did research on drinking water. However, he also performed chemical analysis on cinchona samples send to him by Van Gorkum and experimented with the alkaloid composition of the barks.[75] Through this laboratory work, Moens became well acquainted with the chemical compositions of cinchona and its main alkaloids. The collaboration between Van Gorkum and Moens, stimulated by their close friendship, allowed for a more precise prioritization of attention to specific species in the field station based on Moens' chemical work. With the integration of the new laboratory in Bandung led by Moens and the reorganized field station led by Van Gorkum, another step was taken in the development of the GCE as the autonomous centre of the Dutch cinchona enterprise. Furthermore, it meant a next step in the employment of the laboratory as a new instrument of control in the agricultural and industrial production of cinchona and at the same time in the transformation of the Netherlands Indies into a modern colonial state during the second half of the nineteenth century.[76]

Under the guidance of Moens, first as chemist and thereafter as director, the GCE became an active centre for research and experimentation with cinchona and its active components, exchanging knowledge with the scientific and industrial centres in Europe. Through his active correspondence with leading quinine

[73] Snelders 1993, 106.
[74] Gorkum 1886, 114-115.
[75] Snelders 1993, 106-107.
[76] Cribb 1994, 3-4 and Dick 2002, 15.

manufacturers like the Germans O. Hesse and G. Kerner and Howard in England, Moens became well aware of developments in the pharmaceutical industry.[77] Trained as pharmacist with a strong emphasis on chemical analysis, Moens had learned to appreciate the chemical and pharmacological laboratory-driven approach that was employed in the German ethical pharmaceutical industry.[78] Guided by the objective of profitable cultivation, and his own laboratory research Moens would use his expertise to the improvement of cinchona cultivation in the GCE, especially in the purposeful manipulation of a new high-yield quinine species.[79]

In this endeavour, Moens was also strongly stimulated by his work on the production of the so-called 'quinium,' a mixture of quinine and other alkaloids extracted from the twigs and roots of the cinchona tree, which were not considered to be good enough for European quinine production. In the Dutch parliament, a proposal was accepted that a factory should be established at the GCE for the production of this 'quinium', which would then be sold to pharmacies in the colony as a wine extract.[80] Moens had worked on the improvement of this product and the intention was that Moens would begin mass production of this product in the new factory. Less than one year later in 1873, the production of quinium was suspended due to unusable equipment.[81]

Furthermore, in early 1870s, De Vrij proposed the production and distribution of quinetum in the Netherlands Indies; however, both Moens and Van Gorkum rejected the proposal because of the drug's complex preparation, high price (it was not cheaper than quinine), documented side effects, limited therapeutic value and unstable composition.[82] Ultimately, quinetum was not introduced as an alternative for quinine in the Netherlands Indies because of Moens and Van Gorkum's strong belief that in cinchona cultivation, emphasis had

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[77] See for example correspondence between Howard and Moens in Item JEH/1/35, Royal Botanical Gardens, Kew, London. Algera 1994, 61-72.

[78] Homburg 1993.

[79] *Verslag Gouvernment Kinaonderneming 1873*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

[80] Algera 1994, 148 and *Jaarverslag Gouvernements Kina onderneming 1871*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

[81] Algera 1994, 148-155.

[82] Algera 1994, 148-155.

to be placed on species with a high quinine content instead of species with a high total alkaloid content. In the 1873 GCE annual report, Van Gorkum and Moens thus argued: "For the future of the cinchona cultivation [in the Netherlands Indies] the most important interest is the correct knowledge of the [quinine] content of the *cinchona calisaya ledgeriana*."[83]

Illustration 3: Bernelot Moens visiting K.W. van Gorkum at the Government Cinchona Estate at Tjijiroean, ca. 1870s.[84]

[83] *Jaarverslag Gouvernment Kinaonderneming 1873*, Item L 2050, Colonial Collection (KIT), Leiden University Library. "Het groote belang dat voopr de toekomst der kina cultuur was gelegen in een juiste kennis van het gehalte der *cinhcona calisaya ledgeriana*."
[84] KITLV Digital Image Library, Leiden University.

The species ledgeriana and the emergence of a laboratory-driven crop innovation system

In 1865, Van Gorkum received *calisaya* seeds from Miquel applying them in the GCE's experimentation fields.[85] When Moens began his work in 1872, the seeds had grown into full-grown trees ready to be chemically analysed for their quinine content and hence their future as a possible cultivation variety. Moens discovered that these specific trees contained significantly more quinine than any other trees present in the GCE. However, Van Gorkum's field experimentations had determined the species' fragility. Diseases quickly affected the *calisaya* roots and it quickly lost its high quinine content through cross-pollination with other species.[86] The trees, which would be known as the species *C. ledgeriana Moens*, however, contained such a high percentage of quinine that Moens and Van Gorkum immediately regarded it as an important asset to the cinchona cultivation in the Netherlands Indies.

During the 1870s, Moens created an elaborative laboratory-based method of seed selection that provided seeds and grafts of equal standards. In other words, by using chemical analysis, he could select seeds from the trees that yielded the highest quinine, thus creating a standardized bark of higher quinine content.[87] In the case of the *ledgeriana*, he analysed several trees and in the end selected two so-called 'mother trees' which contained the highest amount of quinine. The seeds of these two trees then were used to form a new line of standardized high-yield quinine trees.[88] At the same time, Van Gorkum performed botanical experiments to determine the best soil and altitude and how to stop cross-pollination with other species. A new field station was created especially for this new line of research and further experiments were started to graft the *ledgeriana* onto *suucirubra* stems (making it less susceptible to diseases). In the process, Van Gorkum and Moens were able to create through a combination of botanical and chemical knowledge and expertise a high-yield quinine species—the *ledgeriana* Moens—that was resistant to root diseases and cross-pollination.

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[85] For an in-depth historical analysis of these 'Ledger seeds' see Gramiccia 1988.

[86] See the various *Verslag(en) der Gouvernements Kina-onderneming* of the 1870s. Item L 2050, Colonial Collection (KIT), Leiden University Library.

[87] Kerbosch 1948, 830-832.

[88] Kerbosch 1948, 831.

So, by closely linking the development of a high quality and profitable cinchona bark species to the rising German pharmaceutical industry's demands to produce drug compounds of high and standardized purity, Van Gorkum and Moens were able to create a whole new cinchona species, the *Cinchona ledgeriana*. At the GCE, cinchona was thus transformed into a Javanese-cultivated plant adapted to the local environment through scientific intervention. In retrospect, Van Gorkum's botanical field experiments and Moens' chemical laboratory analysis constituted a laboratory-based breeding program that laid the basis for a crop innovation system that would become the corner stone of Dutch colonial agro-industrialism, positioning the laboratory as a central device in the improvement and hence profitability of new agricultural crops. But before this would materialize, interest should be aroused in private planters for cinchona cultivation.

Commercialization and cooperative governance

Guided by the government's objective of a profitable cultivation, Van Gorkum emphasized cooperation with private planters and the subsequent commercialization of cultivation was necessary for the future of the cinchona cultivation enterprise.[89] In contrast to British India and Ceylon, private enterprise was limited on Java and the rest of the Netherlands Indies until the late 1860s. As part of the liberalization reforms of colonial private enterprise, the use of European capital and entrepreneurship was slowly allowed. With the enactment of the 1870 Dutch Agrarian Law, private enterprise increased rapidly in the Netherlands Indies and specifically on Java.[90] The interest in cinchona cultivation, however, remained rather limited during the late 1860s. As a result of Junghuhn's 'secret cultivation' and failure to produce a profitable cultivation, cinchona cultivation was still regarded by most planters as a government cultivation program and hence not profitable. According to Van Gorkum in the annual report of 1866, "There is still no evidence of any sight of entrepreneurial sense amongst private persons in case of cinchona. Ignorance or even wrong notions are the reasons for this."[91] There were a few exceptions, since some planters began experimenting with cinchona bark during the late 1860s and early 1870s. Tea planters, e.g., K.F. Holle and Rudolf Kerkhoven, near Bandung did experiment with cinchona and

[89] Goss 2011, 52.

[90] Houben 2002, 66-67.

[91] *Verslag der Gouvernements Kina-onderneming 1866*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

according to Van Gorkum, their promising results "have convinced these diligent entrepreneurs to extend their cultivation."[92]

So, Van Gorkum tried to stimulate more pioneering planters to introduce cinchona on their estates by freely distributing seeds and plants, making announcements in the government's Bulletin of Acts (*Staatscourant*) and publishing manuals on cultivation.[93] Furthermore, he made it possible for planters to visit the GCE and vice versa, exchanging his knowledge on cinchona cultivation.[94] Although the number of planters did not grow exponentially during the early 1870s, more planters began to show an interest and began experimenting in their fields after requesting seeds, plants and information.[95] Thus, by 1870, 10 planters were experimenting with cinchona and this number of planters had risen to 25 by 1873.[96] It was, however, the publication of a specific work and the introduction of the cinchona *ledgeriana* on the European cinchona markets that resulted in an exponential growth of the private cinchona cultivation during the second half of the 1870s and early 1880s.

Under Moens' directorship, the cooperation between the GCE and the private planters was strengthened, thus making the GCE the centre of an emerging scientist-planter network. The number of private planters increased significantly during the late 1870s and early 1880s, partly because of Moens' stimulating publications. In 1878, his work, 'The history of 8,5 bouw Ledgeriana-cinchona' was published in the *Journal for Agriculture and Industry in the Netherlands Indies* (Tijdschrift voor Landbouw en Nijverheid in Nederlandsch-Indië), showing the planters how he had successfully cultivated 8,5 bouws with the *C. ledgeriana* and

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[92] *Verslag der Gouvernements Kina-onderneming 1866*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

[93] Van Gorkum's efforts to stimulate private enterprise can be regarded as part of what Houben refers to as the "colonial state either acted as an entrepreneur or facilitated the commercial interests of Western private entrepreneurs." Houben 2002, 67.

[94] *Verslag der Gouvernements Kina-onderneming 1873*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

[95] *Verslag Gouvernements Kina-onderneming 1870 and Verslag Gouvernements Kina-onderneming 1873*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

[96] *Verslag der Gouvernements Kina-onderneming 1870 and Verslag der Gouvernements Kina-onderneming 1873*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

earned a net income of almost 50 thousand guilders in four years.[97] According to Van Gorkum, "by mentioning the net profit, Moens stimulated the planters' interest in the cinchona trees," which resulted in a "quick expansion of the private cinchona estates".[98] Another factor that stimulated private enterprise was the price paid at the Amsterdam auction of April 17, 1877 for a kilogram of governmental *ledgeriana* bark—17,58 guilders. In comparison, at the same auction *succirubra* bark fetched 3,36 guilders for one kilogram.[99] So, stimulated by these high prices, interest in cinchona bark from the private plantation sector increased and by 1890, the number of cinchona plantations had exponentially grown to 128 cinchona plantations most of which were located in the provinces of Buitenzorg and Priangan (illustrations 4 and 5) in West-Java.[100]

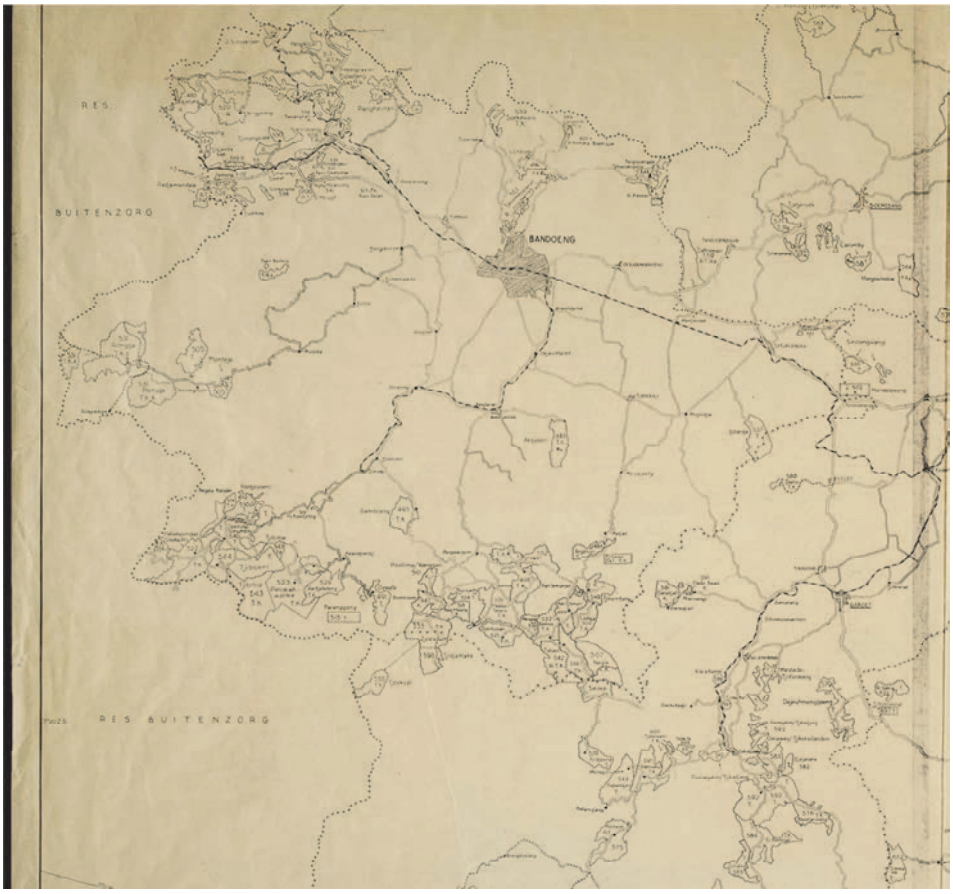
[97] 1 bouw is approximately 7000 m². Moens 1878, 181.

[98] Gorkum (1886), pp. 72-73. See also Kerbosch 1948, 759.

[99] Kerbosch 1931b, 325.

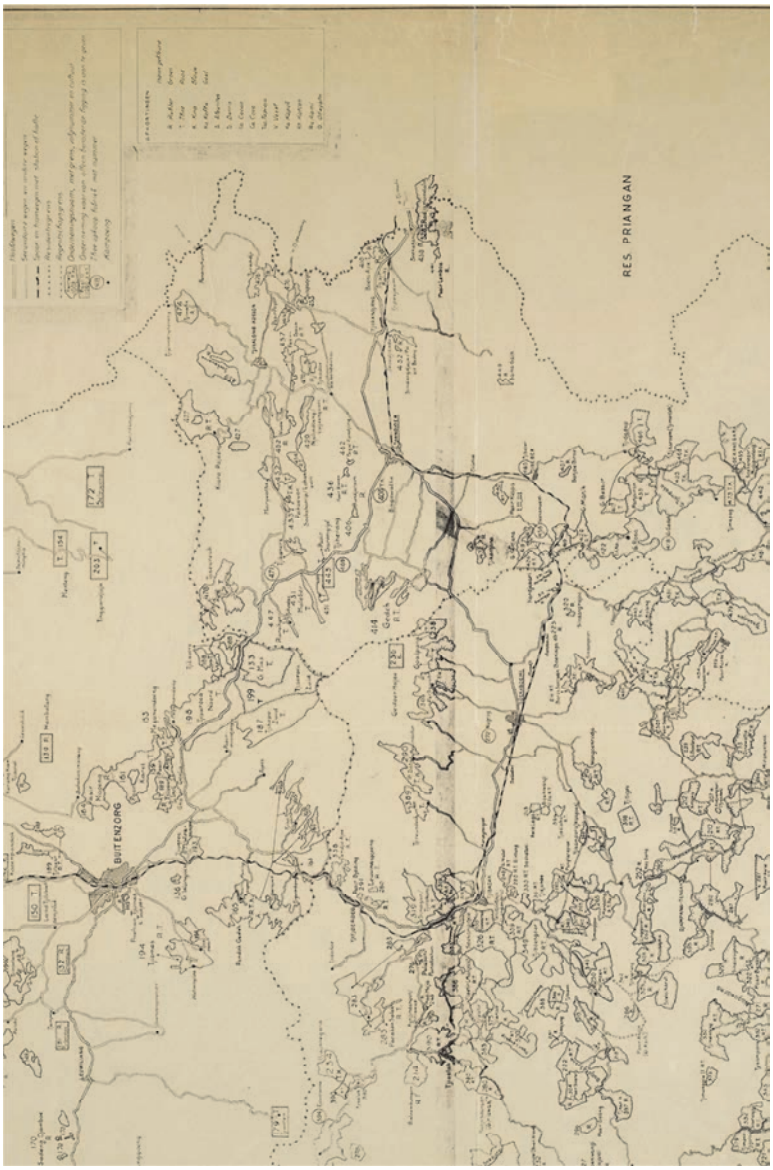
[100] *Handboek voor cultuur- en handelsondernemingen in Nederlands-Indië* (1890).

Illustration 4**:** A part of the residentie (province) of Priangan and the private (cinchona) plantations.[101]



[101] The Royal Tropical Institute Amsterdam, colonial maps collection, Colonial Collection (KIT), Leiden University Library.

Illustration 5: A part of the residentie (province) of Buitenzorg and the private (cinchona) plantations.[102]



[102] The Royal Tropical Institute Amsterdam, colonial maps collection, Colonial Collection (KIT), Leiden University Library

Laboratory-based British production of a cheap febrifuge

With the objective to secure abundant and cheap (quinine) febrifuge for the Empire, the British government prioritized the production of cheap febrifuge over the improvement of the cinchona cultivation during the late 1860s and 1870s.[103] According to a Secretary of State for India, the cinchona government plantations "should not be to grow the largest amount of Quinine-yielding barks simply, but to grow the bark yielding the largest percentage of febrifuge alkaloids generally."[104] Stimulated by Howard and De Vrij's work on the therapeutic value of alternative febrifuges, this opened the way for the integration of laboratory analysis in the extraction of non-quinine alkaloids from the cinchona bark.[105] In 1866, the first of a group of chemists was appointed to the Government Cinchona Plantations of Ootacamund in the Nilgiris hills in order to find a workable and cheaper method to manufacture quinetum from mixed alkaloids. This ultimately resulted in the production of an alternative 'cinchona febrifuge' in the Bengal Quinine Factory from 1875 onwards.[106]

The government prioritization, however, had two important consequences. First, chemical laboratory analysis of the barks and their quinine content was not integrated in the British cinchona breeding and cultivation program.[107] Instead, emphasis was on the breeding and cultivation of the existing species *succirubra* and *officinalis* rather than the harder-to-propagate species like the *calisaya.*[108] Second, in contrast to the relative autonomous position of the GCE on Java, both laboratory research and cinchona cultivation on the government estates were guided and controlled by the Indian Office in London. Under the direct guidance of the Royal Botanical Gardens of Kew, the Indian Office decided on the course of cinchona and febrifuge research in India.[109] The primary objective was to

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[103] Brockway 1979, Drayton 2000, Veale 2010 and Mukherjee 1998.

[104] Cited in Duran-Reynals 1946, 203 and Veale 2010.

[105] Algera 1994, 148-156, Muraleedharan 2005, 37, Gammie 1888, 140 and Veale 2010, 104.

[106] Veale 2010, 162-167, Holland 1932, 6 and Gammie 1888, 141.

[107] Kumar 1995, 153-154.

[108] Holland 1932, Veale 2010, 158-170 and Letter from J. Broughton, Government Quinologist to Secretary of Government, Revenu Department Fort St. George, dated Ootacamund, 31st July 1871, JEH/2/4-9, Royal Botanical Gardens, Kew, London.

[109] Algera 1994, 75-76, Veale 2010, 162-170 and Letter Herman Meravile to Howard, 5th December 1873, JEH/1/14, Royal Botanical Gardens, Kew, London.

develop a laboratory-guided production line of cheap febrifuges for the sake of the Empire and to help strengthen colonial rule.[110]

Table 4: Alkaloid content of the four commercial cinchona species in percentages.[111]

	Quinine	Kinidine	Cinchonidine	Cinchonine
C. ledgeriana	5-13	0-0,5	0,1-1,5	0,2-1,5
C. succirubra	1-1,25	0-0,1	2-2,5	1,5-4
C. officinalis	2-4	0-0,3	0,4-1	1-3
C. pahudiana	0,2	0	0,4	0,5

Market/industry preference and private enterprise-government interaction (1880s-1890s)

Between 1867 and 1877, the total number of hectares cultivated with cinchona in Ceylon had grown from 20 to 2257, respectively.[112] With the absence of Dutch bark and political unrest in South America during the second half of the 1870s, the prices for *succirubra* and *officinalis* were high. This resulted in an increasing number of planters turning to cinchona.[113] By 1880, approximately 1.2 million pounds of bark were exported from Ceylon.[114] In comparison, in the same year, the Dutch GCE had exported approximately 4200 half kilograms and no private bark had been sold.[115] Just as in the governmental plantations on the Indian continent, most of the cultivated trees on Ceylon belonged to the species *succirubra*, "owing to the rapid growth and the prospect it gave of a quick return."[116] As a result, the production of Ceylonese barks reached its zenith by the mid-1880s and approximately seven million kilograms of cinchona bark were exported to

[110] Holland 1932, 4. In this regard, Rohan Deb Roy argues for the early 1900s: "Even within the sanctified confines of various state-endorsed quinine factories, the process for manufacturing 'cheapest possible pure quinine' remained ever contested and elusive." Deb Roy 2013, 67.
[111] Groothoff 1925, 85.
[112] Dethloff 1944, 30.
[113] Veale 2010, 167-168.
[114] Hamilton 1883.
[115] Hanlo 1882, 390-392.
[116] Wilson and Mirchandani 1939, 5 and Brockway 1979, 122.

Europe.[117] However, by this time, as illustrated by figure 2, Dutch planters began to enter the market.[118] As quickly as the planters in Ceylon had taken over the cinchona markets, they lost them to the Dutch. By the end of the century, only a fraction of the cinchona cultivation occurred in Ceylon; the total number of acres cultivated with cinchona dropped from almost 26,000 acres in 1883 to a mere 482 in 1898.[119]

An important reason for the cinchona growers in Ceylon to abandon cultivation was the preference for the higher content of quinine in Dutch barks.[120] By the last quarter of the nineteenth century the pharmaceutical industry witnessed considerable changes. In an attempt to position itself as a valuable partner for pharmacists and physicians, the industry began to reorganize. Standardization and quality control became the most important factors in maximizing the economic value of its products, but more importantly to ensure that preparation errors would not result in a bad reputation or liability.[121] In the production of quinine, an important development was the standardization of the semi-finished product of quinine sulphate. This entailed standardizing the process of extracting quinine sulphate from the cinchona barks by constantly refining the conversion method in industrial laboratories.[122] This resulted in a stronger connection between the laboratory standardization of the quality of the raw material and that of the semi-finished product.

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[117] Dethloff 1944, 28.

[118] *Handboek voor cultuur- en handelsondernemingen in Nederlands-Indië* (1891).

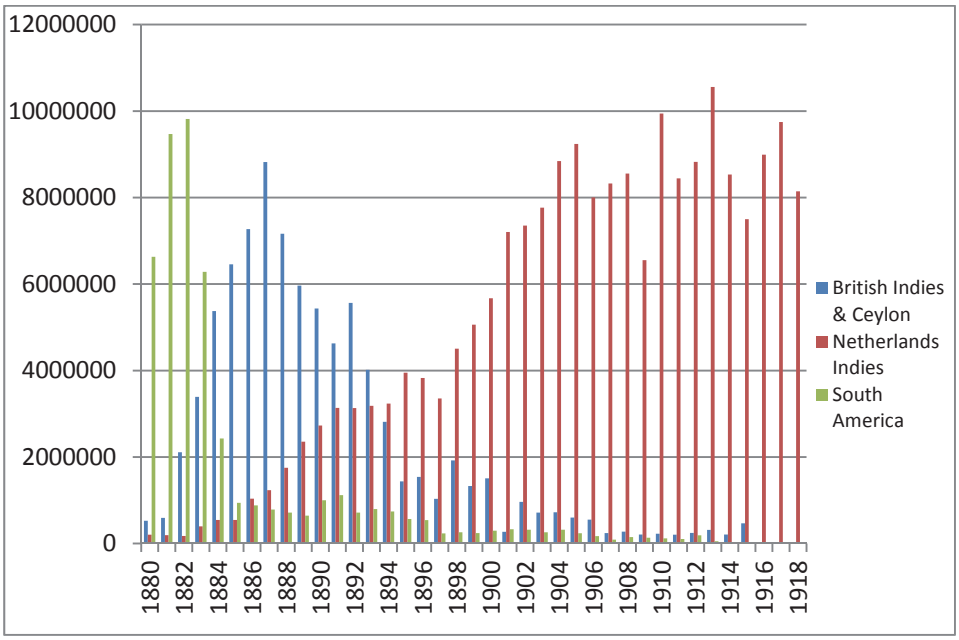
[119] Dethloff 1944, 30-31.

[120] Dethloff 1944, 36.

[121] Gaudillière 2008, 68-69.

[122] A similar process was the conversion of cocaine from coca leaves (by the same German pharmaceutical industry) during the 1880s. See Roersch van der Hoogte and Pieters 2013, 102-104.

Figure 2: Cinchona bark exported in kilograms, 1880-1918[123]



Commerce, industry and the standardization of quinine[124]

As aforementioned, by the mid-1870s, the pharmaceutical-medical debates regarding the therapeutic value of quinine and other mixed cinchona alkaloids febrifuges had resulted in medical science's preference for quinine over alternative febrifuges and hence the pharmaceutical industry's preference as well. An important factor in this shift was the growing attention in foremost the German industry for the extraction and further purification of quinine sulphate as an important semi-finished product for quinine medicines. By the second half of the 1870s, chemists such as G. Kerner at the Verenigte Chininfabriken Zimmer & Co. and L. Schäfer at Boehringer & Co, were constantly refining the extraction process of quinine sulphate from the bark.[125] The establishment of the Amsterdamsche

[123] Dethloff 1944.

[124] See the next chapter for a more in-depth analyse of the cinchona trade, the Cinchona-establishment and the Dutch quinine industry.

[125] Ziegler 2003, chapter 6.

Chininfabriek (ACF), the first Dutch factory that produced the semi-finished product quinine sulphate, relied heavily on German expertise and technology.[126]

Laboratory research became an integral part in standardizing the production process in the German pharmaceutical industry with a strong emphasis on enhancing the quality standards of the final and semi-finished products.[127] The constant search for higher quality and standardized quinine sulphate preparations is well-illustrated during the late 19th century by the multiple awards handed out during (international) conferences to manufacturers whose quinine sulphate product met the highest standards of purity and quality.[128] An important aspect in the purification of quinine sulphate was to exclude other cinchona alkaloids as much as possible.[129] Parallel to the laboratory standardization of quinine sulphate and quinine medicines, more emphasis was placed on the quality of the raw material—the cinchona bark. The barks not only had to contain high amounts of quinine, but also low amounts of other alkaloids, thus making the process of purification much easier and cheaper.

Standardization and quality control also became important in the cinchona commerce by the 1880s and 1890s. Because cinchona bark was priced according to the quinine content, chemical analysis was necessary to determine the content and hence the price. This meant a close collaboration between quinine industrialists, cinchona traders and chemists. In 1886, this collaboration was institutionalized in the founding of the so-called Cinchona-establishment (Kina-etablissement) in Amsterdam.[130] The goal of the Cinchona-establishment was to improve trade in cinchona and its most important customer was the (German) pharmaceutical industry. To secure the quality of the barks, the Cinchona-establishment cooperated with the private cinchona laboratory Moens, van der Sleen &

[126] Wielen 1931.
[127] Cunningham and Williams 1992, Liebenau 1987, Wimmer 1994, Travis, Schröter, Homburg & Morris 1998 and Church and Tansey 2007.
[128] Algera 1994, 78.
[129] Ziegler 2003, 103.
[130] Wielen 1903, 218. See also, Jonker and Sluyterman 2000, 201.

Hekmeijer, situated in Haarlem, the Netherlands where barks were chemically analysed for their quinine content.[131]

The founding of the Cinchona-establishment illustrates the developments within the cinchona and quinine industry and shows how the Dutch managed to incorporate scientific-technological improvements of the pharmaceutical industry in the commerce of cinchona bark. Whereas the Cinchona-establishment became a central institution in the commerce of cinchona, the GCE, back in the Netherlands Indies became the nodal point in the production of high quality cinchona. Both institutions thus strengthened the development of a cinchona production and distribution network and hence contributed to the construction of the Dutch colonial agricultural-industrial system and the commodification of colonial science.

Cooperative governance, innovation and the building of a Dutch scientist-planter network

As mentioned earlier, under the directorships of Van Gorkum and Moens, the GCE grew to be an autonomous and scientific colonial centre for the cultivation of high yielding quinine barks. The close connections with the European scientific and industrial centres of quinine provided them with essential knowledge on standardization and quality control of the semi-finished and finished products. In turn, they applied this knowledge in the production of standardized and high quality barks and made it possible for planters to become well acquainted with the demands of the pharmaceutical industry for high quality barks. Thus, Van Gorkum and Moens laid the basis for a scientist-planter network, which was extended under their successors.

With a growing private sector in the 1880s, the GCE was no longer the only commercial producer of cinchona in the Netherlands Indies. In order to guarantee the future of the cinchona cultivation in the Netherlands Indies as an important colonial commodity, the scientific directors of the GCE stressed the importance of government control, especially in the constant scientific improvement of the barks' standardization and quality. Under the directors Richard van Romunde (1882-1892) and Pieter van Leersum (1892-1914), the GCE gradually began to strengthen its role as an agricultural field station in an expanding

[131] Wielen 1903, 218-219 and Dienst der belastingen in Nederlandsch-Indie 1925, 35-36. On the role of the private laboratory in commerce and industry in the Netherlands, see Vledder, Houwaart & Homburg 1999, 249-290.

private cinchona sector.[132] Although the GCE did not abandon the commercial production of barks, its main goal, as stated in the annual report of 1890, was to increase the barks capital in order to meet the "mission" of the Government and fulfil the wishes of private industry.[133] In other words, the GCE's main task was to scientifically increase the barks' quality and hence create a profitable export commodity.

Van Leersum, who was a pharmacist like Moens and Van Gorkum, continued to work on the improvement and standardization of the barks' high-yield quinine qualities in correspondence with the developments in the pharmaceutical industry.[134] In close collaboration with the colonial government, in 1903, Van Leersum was able to construct a new laboratory for the GCE. This time, however, the laboratory was not situated in the city of Bandung, but instead at the centre of the GCE next to the experimentation fields.[135] By establishing an 'in-house' laboratory, the GCE's scientific directors had transformed the institution from an isolated colonial institution by the late 1850s into a nexus of a laboratory-driven crop innovation system with strong connections to private planters, colonial government and the international cinchona and quinine trade and industry by the start of the twentieth century. As such, both science and the locality had changed in the process of GCE becoming a scientific centre.[136]

(Colonial) knowledge governance and lack of innovation in the British cinchona network

In contrast to the Dutch cinchona program, in the last two decades of the 19th century, British private cinchona cultivation disappeared and only a small government cinchona cultivation program remained to provide the raw material

[132] The incorporation of scientific research for the improvement of the product quality was not only restricted to the cinchona culture. The mid-1880s agricultural crisis resulted in the restructuring of Java's plantation enterprises and according to Houben "more attention was paid to scientific principles, to product quality, and to costs of production." Houben 2002, 72.

[133] *Verslag der Gouvernements Kina-onderneming 1890*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

[134] Various *Verslagen Gouvernements Kina-onderneming*, Item L 2050, Colonial Collection (KIT), Leiden University Library.

[135] *Verslag Gouvernements Kina onderneming* 1902-1903, Item L 2050, Colonial Collection (KIT), Leiden University Library.

[136] Latour 1987.

for the production of alternative cinchona alkaloid febrifuges.[137] Why then did the Ceylonese planters, who by the mid-1870s had obtained seeds, not begin cultivating the preferred *ledgeriana* on the same scale as the Dutch? In the historical literature, no satisfactory answer is provided and most pinpoint the ideological and symbolic function of the cinchona enterprise for the British Empire and Kew Gardens. The intention of the British Imperial government from the start was the production of cheap febrifuges for the supply of the vast armies of colonial officers in India and the Empire. An intention which, as Rohan Deb Roy argues, "exposed several fault lines and tensions of empire."[138] For Kew Gardens, the cinchona enterprise symbolized the importance of botanical knowledge and the acclimatization of exotic plants as central for the progress of the Empire and its subjects.[139]

However, by closely looking at the interplay between science, industry and government, two other interrelated factors can be added. First, emphasis on the production of alternative febrifuges resulted in the separate development of laboratory research and improvements in the cinchona cultivation. British chemists worked on the chemical improvement of the cinchona alkaloid febrifuges, while after the death of McIvor in 1876, cinchona cultivation was "thrown into the hands of those who have had so little of the requisite training and experience in systematic botany for dealing with it effectively."[140] Second, British emphasis on cheap febrifuge resulted in less attention to cinchona as a profitable tropical agricultural commodity and to the developments in the pharmaceutical industry and the related standardization and quality improvement of the semi-finished product quinine sulphate as well as the raw material (cinchona barks). For the government, there was no need to have an autonomous scientific centre in India that could support the cinchona industry of Ceylon scientifically and financially. As a result, the profit-seeking private planters just switched from one crop to another without paying much attention to crop innovation.[141]

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[137] Veale 2010, Muraleedharan 2005 and Brockway 1979.

[138] Deb Roy 2013, 78.

[139] Drayton 2000, Philip 1999 and Brockway 1979.

[140] Trimen 1883. See also Veale 2010, 171-177.

[141] Historically we find Ceylonese agriculture dominated by spices, then coffee, then cinchona and finally tea. McCracken 1997, 133.

Conclusion

The historical trajectories of cinchona in the Netherlands Indies and British India thus show two disparate networks of exchange and control among scientists, state-officials, planters and industrialists, and hence two distinct nascent colonial agro-industrialist systems. The historical comparison between the Dutch and British cinchona cultivation enterprises, thus, illustrates how a process of colonial agro-industrialism with different vectors of assemblage became manifest by the late nineteenth and early twentieth century.

The Dutch, whose objective was to make the colony profitable, emphasized the constant scientific improvement of the cinchona cultivation in order to produce a high quality and profitable cinchona bark product with a high quinine content (raw material) for the pharmaceutical industry in Europe (foremost Germany). Through the circulation of knowledge and expertise with the scientific and industrial centres in Europe, state-scientists like Moens, Van Gorkum and Van Leersum were well aware of the laboratory-guided standardization and quality control efforts in the pharmaceutical industry. The implementation of a quality control laboratory created a GCE that could present itself as an autonomous colonial scientific centre for crop innovation, where the constant improvement and standardization of cinchona barks' quality connected to the increasing industrial role of the laboratory in product quality control. In addition, the introduction of the laboratory at the Government Cinchona Estate created an agricultural field station in which the latest know-how was put into practice in creating new knowledge (e.g. a new cinchona species). As such the vectors of assemblage in the Dutch case are an early example of commodification in colonial science and hence the introduction of the laboratory for commercial ends by the Government Cinchona Estate can be regarded as a forerunner of Treub's Botanical Garden and the agricultural field station as the scientific centre of the Netherlands Indies agricultural export economy.

In British India, on the contrary, no such colonial nexus developed around cinchona cultivation. From the start, the cinchona enterprise was imperial metropolitan driven. An important role was given to Kew Garden in the introduction and acclimatization; however, it never established itself as a nexus of a cinchona and quinine production and distribution network. For Kew's directors, the cinchona cultivation was more a means to an end of maintaining its role as a metropolitan centre that sustains a colonial network of exchange and control.

Furthermore, the two government cinchona estates in India sticked to the imperial objective of securing abundant bark for the production of febrifuges. As such, no scientific centre dedicated to cinchona cultivation developed in India, as the GCE in the Netherlands Indies did. Furthermore, in British India, chemical analysis in the laboratory was thus mainly reserved for the improvement and production of alternative febrifuges that were instrumental in strengthening colonial rule.

So, by the turn of the twentieth century, cinchona cultivation in British India and Ceylon remained foremost a government-led cultivation of a small production of anti-febrifuge medicines for imperial purposes.[142] Meanwhile, as I will show in the next chapter, the Netherlands Indies succeeded in monopolizing the worldwide supply of cinchona bark and thus became the backbone of a Dutch-controlled international cinchona and quinine cartel.

[142] In regard to the British colonial cinchona cultivation in the twentieth century see, Gage 1918, Holland 1932, Duran-Reynals 1946, Brockway 1979 and Mukherjee 1998.

Chapter 2. Science, industry and the colonial state
A shift from a German- to a Dutch-controlled cinchona and quinine cartel (1880-1920)[1]

The development and subsequent commercialization of the laboratory-conditioned *Ledgeriana* Moens species by the GCE during the 1870s and 1880s created the conditions for the emergence of a cinchona network of planters and traders across the Dutch colonial empire by the turn of the twentieth century. As illustrated by figure 2, this Dutch cinchona network was able to outcompete the natural production sites in South America and the cinchona cultivations in British India and Ceylon and hence monopolise the worldwide supply of cinchona bark. Nonetheless the dominance of the worldwide supply of cinchona, however, the cinchona planters and traders remained strongly dependent from their largest buyers, the German pharmaceutical industry, which by the turn of the century controlled the worldwide quinine markets through an international quinine cartel. By 1920, the tables had turned and a network of Dutch cinchona producers and quinine manufacturers dominated the international cartel that controlled the worldwide production and distribution of quinine (final product), quinine sulphate (a semi-finished product) and cinchona (the raw material). So, how can we understand the shift of power in the world's first pharmaceutical cartel? In this chapter, I will argue that the internal shift of power (e.g. control) was largely the result of the following three factors: increasing laboratory control of cinchona bark, quinine sulphate and quinine medicines; the establishment and maintenance of a transoceanic network of cinchona producers, quinine manufacturers, (colonial) scientists and state officials across the Dutch Empire; and Germany's economic isolation during the First World War.

During the last quarter of the nineteenth century, the Netherlands Indies' agricultural export economy was transformed in accordance with new ideas of liberal trade. The colony became accessible for European private capital, which made it possible for rapid growth of the private agricultural export economy.[2] Since the time of the Dutch East India Company, the Netherlands Indies had

[1] A shortened version of this chapter was published in *History and Technology: An International Journal*. Roersch van der Hoogte and Pieters 2015.

[2] Jonker and Sluyterman 2000, 177-180, Zwaag 1991, 27-32 and Van Zanden 2010, 170-173.

always been regarded as a profit-making colony (*Wingewest*). Between approximately 1830 and 1870, the so-called 'Cultuur Systeem' (Cultivation System) was in place. In this system, hierarchical and autocratic lines of power were used to force the colonial population to reserve part of their fields for the cultivation of export crops like sugar, coffee and indigo to provide profit for the colonial state and hence the motherland. In the two decades after the enactment of the Dutch 1848 Constitution and the introduction of fundamental political liberal reforms in the Netherlands, Dutch liberal politicians were confronted with an agricultural and coercive state monopoly. Therefore, during the second half of the nineteenth century, a more liberal system of colonial exploitation was put in place. An important aspect of the liberalization of the Netherlands Indies economy was the central role of so-called Dutch colonial business networks or elites in the shaping of the Netherlands Indies colonial state at the turn of the twentieth century.[3] According to Arjen Taselaar, liberal legislation in the years 1870-1872 provided the juridical framework and 'open door' policy for the economic exploitation of the Netherlands Indies by private business.[4] This attracted young adventurous men, such as the tea and cinchona planter Rudolf Kerkhoven, whose life is romanticized in the novel *Heren van de Thee* by Hella Haasse, to establish themselves as agricultural entrepreneurs (*ondernemingslandbouw*) in the still largely untouched and wild mountains of Java.[5] However, it was not until the last years of the nineteenth century and the first decade of the twentieth century that Western business in the Netherlands Indies gained momentum. This coincided with the political and economic expansion and integration of the Outer Islands in the Netherlands Indies colonial state by the turn of the century.[6] As such, a phase of economic expansion began that lasted until the eve of the worldwide Great Depression in 1929-1930 in which large scale capital investments were made in the expanding plantation economy.

This economic expansion resulted in a process of large capital investments together with a scaling up of the export agriculture and the concentration of

[3] Kuitenbrouwer and Schijf 1998, 72.

[4] Taselaar 1998, 26.

[5] Haasse 1992.

[6] Taselaar 1998, 37 and Lindblad 1993, 700. Not to mention the innovations in transport and communication by the late nineteenth century, which made the geographical distance between the colony and metropolis smaller. See amongst others, Jonker and Sluyterman 2000, chapter IV and Woude 2010.

plantations in the hands of investment companies and joint ventures situated in the Netherlands Indies and to a larger degree in the Netherlands.[7] As such, a complex and extensive business network of administrators, superintendents, middle management and owners was being formed in the Netherlands Indies and the Netherlands at the turn of the century. Kuitenbrouwer and Schijf concluded that the colonial business elite during the turn of the century largely overlapped with the network of business elite in the Netherlands. Both networks consisted foremost of the directors and board members of trading companies, banks, investment companies and transportation companies.[8] By the first decade of the twentieth century, as Taselaar has shown in the case of rubber and tea plantations (which together with cinchona and coffee belonged to the so-called *bergcultures* or mountain cultivations), firms like D. M. & C. Watering, Tiedeman & van Kerchem, and Van Heeckeren & Co. began to dominate the production and trade of colonial agricultural export crops.[9] These companies formed a network of planters and traders, which also dominated the Dutch cinchona cultivation network by the early twentieth century.

At the same time, the Netherlands saw a first wave of industrialization in sectors including metals, food and foodstuffs, while profiting from (amongst others) a growing domestic market, an increase in the population and the expansion of a transport system (e.g., railroads and canals).[10] Stimulated by the discovery of coal in the province of Limburg and the growing exploitation of the Netherlands Indies' reserves by the late nineteenth century, Dutch industrialization received an extra boost.[11] This in turn, stimulated the introduction of new modes of acquiring and diffusing technology, which led to the establishment of research departments at companies. In 1885, for example, the first industrial laboratory was set up at the Nederlandse Gist- en Spiritusfabrieken (NGSF), which was followed quickly by industrial laboratories in companies like Philips and Royal Dutch Shell by the end of the century.[12] The development of these laboratories and their

[7] Taselaar 1998, 42 and 160-161, Kuitenbrouwer and Schijf 1998, 61 and Lindblad 1993, 703-705.

[8] Kuitenbrouwer and Schijf 1998, 67-71. See also for the Netherlands, Schijf 1993.

[9] Kuitenbrouwer and Schijf 1998, 73-79 and Jonker and Sluyterman 2000, 201-206.

[10] Schot and Rip 2010, 18. See also, Woude 2010.

[11] Schot and Rip 2010, 18.

[12] Baggen, Faber and Homburg 2010, 282-286 and Faber 2001.

innovative functions, were stimulated by new generations of technicians, educated at the new technical schools, who formed new structures of cooperation as they began to work in the various companies.[13] As such, creating the first scientist-industrialist networks served to spread new scientific and technical knowledge at all levels and stimulated the young Dutch industry in the creation of new knowledge.[14]

As part of this process of Dutch nation-state building in the Netherlands, I will show in this chapter how a Dutch quinine industry was established in close interaction with the colonial cinchona network across the Dutch colonial empire at the turn of the century. First I will describe how a cinchona network was established around the laboratory-controlled production of a high-quality raw material in the Dutch colonial empire between roughly 1880 and 1910. Second, I will show how two Dutch-controlled quinine factories were able to position themselves as strong competitors of the German quinine industry, open up the German-led cartel and subsequently take the lead within in the cartel. Thirdly, the focus is on how the colonial state's involvement and interventions resulted in connecting the cinchona and quinine networks across the Dutch colonial empire. In the final part of this chapter, I will discuss how the First World War proved to be an important factor (catalyst) for connecting the various networks and allowed the Dutch to establish control over the international cinchona and quinine markets.

The emergence of a cinchona network in the Dutch Empire (1880-1910)

With the introduction of the high-quality *Ledgeriana* Moens species by the GCE, private planters showed a growing interest in cinchona cultivation. This growth also stimulated cinchona trade within the Dutch empire and by the late nineteenth century, several trading houses were involved between the Netherlands Indies and the Netherlands. By the turn of the twentieth century, a cinchona bark trade network of (state-sponsored) scientists, planters and traders was forming

[13] Faber 2001, 18-22, Homburg, Rip and Small 2010, 261-280.
[14] Homburg 2003 and Baggen, Faber and Homburg 2010, 280. See also Faber 2001.

within the Dutch empire.[15] The formation of this network, however, required hard work.

By the late nineteenth century, the cinchona network was divided into two sub-networks: one primarily based in the Netherlands Indies consisting mostly of private planters, supported by the GCE and the colonial state, and the other primarily based in the Netherlands and consisting of traders, brokers and chemists working at private laboratories. A central factor that bonded these two networks into one emerging cinchona network by the early twentieth century was the role of the laboratory and specifically the application of chemical analysis. In contrast to other colonial export commodities, the value of cinchona bark as a raw material was determined by the amount of the semi-finished product quinine sulphate present in a kilogram of bark.[16] Chemical analysis was necessary to determine the amount of quinine-sulphate, thus making these analyses central in the production and trade of both cinchona and quinine sulphate. By the late nineteenth century, chemists conducted these analyses in colonial state laboratories, private laboratories, and principally in industrial laboratories of the (German) pharmaceutical industry.[17]

I argue that the integration of these two sub-networks into one colonial cinchona network linking the Netherlands and the Netherlands Indies was the result of a process in which the laboratory materialized as a key site, highlighting chemical analysis and standardization of the production and distribution as critical modes of knowledge. In this process, the GCE as a scientific and coordinating centre for cinchona breeding, cultivation and quality control played a crucial role.

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[15] Andrew Goss has argued that with the formation of the *Vereeniging ter Bevordering van de Belangen der Kinacultuur* (Association for the Advancement of the Interests of the Cinchona Cultivation) in 1894 in Amsterdam, 'collective organization in the Netherlands Indies became more formal'. Goss 2014, 12.

[16] Kerbosch 1924, 437.

[17] Vledder, Houwaart and Homburg 1999. On the existence of various kinds of laboratories, see Rooij 2011.

The scientist-planter network in the Netherlands Indies (ca. 1880-1900)

As mentioned in the previous chapter, by 1890, after the introduction and promotion of the *Ledgeriana*, the Netherlands Indies cinchona cultivation in the Netherlands Indies consisted of 128 plantations. Of these 128 plantations, approximately 52% were financed by private capital and managed and owned by individual planters living in the Netherlands Indies. The others were managed and/or owned by joint ventures, and financed mostly by shareholders from trading companies and investment firms in the Netherlands Indies and the Netherlands.[18] Cinchona cultivation in the Netherlands Indies thus consisted of diverse plantation ownership, which made cooperation across all cultivation rather difficult.[19] In 1904, one of the most experienced and long-time cinchona planters, C.H.O.M. von Winning, remarked: "If the Java planters had taken cooperative action, then they would had no problem controlling the market. Instead, they are now dependent on traders, brokers and foremost the quinine industry for buying, and hence, setting up the prices."[20] It was foremost through the steering role of the Government Cinchona Estate and the colonial government that a scientist-planter network was formed during the 1880s and 1890s and then became part of the emerging cinchona network.

Like their British counterparts, the Dutch planters also suffered from the low prices and did not trust the government's role as a cinchona producer and hence cinchona competitor. Although the GCE had actively supported the establishment of private cultivation – for example, providing information on cultivation techniques and distributing seeds, plants and grafts of high-quality cinchona to planters – by the late 1880s and 1890s the majority of the private cinchona planters regarded the cultivation activities of the GCE as unfair

[18] *Handboek voor cultuur- en handelsondernemingen in Nederlands-Indië* (1890).

[19] Complications in the cooperation, however, were not unfamiliar in the late nineteenth century Netherlands Indies plantation economy. According to Roger Knight, in the sugarcane industry there were considerable difficulties "in the way of taking collective action of any kind during the closing decades of the nineteenth century." Knight 2013, 102.

[20] Winning 1904.

competition.[21] Confronted by declining prices for cinchona bark, the planters argued that the GCE was able to produce and export relatively large amounts of cheap bark because of government support.[22] Some planters argued that the private industry was very well capable of standing on its own and "the cinchona culture on Java would suffer no loss if the government cinchona estate would disappear."[23] However, most favoured the position of the GCE as an experimental field station for the cinchona industry (*proefstation*), where "the best ways of soil development, harvesting, etc., should be followed and where all experiments necessary should be conducted."[24] Colonial state experts such as the director of the Botanical Garden at Buitenzorg, Melchior Treub and the former director of the GCE, K.W. van Gorkum, supported the idea of the GCE as a scientific centre (field station) and the colonial government suit followed the planters criticism.[25] In 1894, for example, the Governor-General advised the Minister of Colonies, after having received a request of a group of eighteen cinchona planters to transform the GCE in its entirety into an experimental field station for the (private) cinchona cultivation:

> "By limiting the Governments cinchona estate within the confines of an experimental field station, this would provide the private cinchona culture much benefit, not only because that will mean

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[21] Schrijven particuliere ondernemers aan Gouverneur-Generaal, 4 augustus 1893, Verbaal no. 19, 6 december 1894, item 4884 Archief Ministerie van Koloniën 1851-1900, Nationaal Archief, Den Haag.

[22] Schrijven particuliere ondernemers aan Gouverneur-Generaal, 4 augustus 1893, Verbaal no. 19, 6 december 1894, file 4884 Archief Ministerie van Koloniën 1851-1900, Nationaal Archief, Den Haag.

[23] "De Gouvernements Kinatuinen op Java," *De Locomotief* XXXVI, no. 225 (28 Sept. 1887).

[24] "De Gouvernements Kinacultuur," *De Locomotief* XXXIV, no. 153 (26 June 1885). In addition, the Association for the Advancement of the Interests of the Cinchona Cultivation (founded in 1894) requested the Minister of Colonies, "that the Government Cinchona Estate function as a provider of cuttings and advice only. Goss 2014, 12.

[25] Although he returned to the Netherlands in 1880 (after resigning as a colonial state official), Van Gorkum remained closely involved with the cinchona cultivation. In regard to this particular issue he was convinced that "the private industry is still not capable of standing on its own and it would be irresponsible if the Government, after having achieved so much good, will leave the cinchona culture on its own." Cited in "De Gouvernements kina-onderneming," *Java-Bode* 35, no. 137 (12 June 1886). On the life of Van Gorkum, see Wielen 1910.

> that they would be freed, justified or not, from Government competition, but also because as such they would receive healthy and quality plant material and get information for solutions regarding all the cultivation related questions."[26]

Despite the planters' criticism and the policy line set forth by the colonial government, the GCE remained the largest individual cinchona plantation in the colony, producing approximately one tenth of the export of cinchona bark in the Netherlands Indies during the late nineteenth century.[27] Nonetheless, the GCE directors Van Romunde and Van Leersum, as mentioned, gradually began to strengthen the role of the GCE as an agricultural field station to directly support the private cultivation activities of the planters. In doing so, they partly acknowledged the planters' criticism and at the same time positioned the GCE as the scientific and coordinating centre of the Netherlands Indies' cinchona cultivation. The commercial exploitation of the GCE also ensured that adequate capital was reserved for GCE's improvement as a scientific centre. In 1903, in order to enhance the technological capability of the GCE, an 'in-house' laboratory was built on the GCE's premises to improve cultivation conditions, the chemical-analysis of the soil and quinine-sulphate content, and to perform experiments to optimize the extraction of the semi-finished quinine sulphate from the bark.[28] In 1911, this laboratory became part of the newly founded Government Cinchona Field Station where botanists and plant physiologists investigated essential cultivation problems like crop diseases and worked on the constant improvement of the crop's quality.

The establishment of the Government Cinchona Field Station henceforth was part of the overall policy of the new director of the Department of

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[26] "Door de beperking van de Gouvernements kina onderneming binnen de grenzen van een proefstation zou de particuliere kinacultuur veel baat vinden, niet alleen omdat zij zodoende van de terecht of ten onrechte gewraakte concurrentie der Regeering ontslagen zou raken, maar ook omdat zij daar gezond en waardig plantmateriaal zou kunnen bekomen en voorlichting zou kunnen vinden voor de oplossing van al de cultuur betreffende vragen." Van der Wijck to Van Dedem, 3 May, 1894, no. 787a/16, in Verbaal December 6 1894, no. 19, file 4884, Archief Ministerie van Koloniën, 1851-1900, Nationaal Archief, Den Haag.

[27] Gorkum 1896, 122.

[28] Between 1872 and 1903, the GCE's laboratory was situated in the city of Bandung. Kerbosch 1924, 429.

Agriculture, Industry and Commerce, H.J. Lovink (1866-1938) to improve the colonial agriculture through scientific research.[29] The founding of the department of Agriculture (which in 1911 became Agriculture, Industry, and Commerce) illustrates the growing involvement of the colonial state in the colonial agriculture.[30] Especially under Lovink, between 1909 and 1918, the department of agriculture became a central governmental institution for agricultural research. Lovink created different divisions, such as a phytopathology service for plantation crops laboratories for chemical, geological and bacteriological research. Besides, he made the Botanical Garden at Buitenzorg a separate division, which contained amongst others laboratories for botany, zoology and pharmaceutics.[31] With the incorporation of Industry and Commerce in 1911, the department became the "main governmental body for colonial technological development in the twentieth century."[32]

The GCE also became a coordinating centre when, by the 1890s, director Pieter van Leersum took an active stance as spokesman for the Netherlands Indies' cinchona cultivation.[33] During the next decade, Van Leersum's "diligence and dedication" placed him at the centre of the Netherlands Indies' cinchona cultivation as he organised meetings, stimulated planters to cooperate more fully, lobbied with the colonial government to protect the "importance" of the cinchona cultivation as an export crop and exchanged knowledge regarding cinchona breeding, cultivation and quality control with the private planters.[34] For example, the formation of a European quinine cartel in 1894 (see next section) caused serious distress amongst the cinchona planters, who feared that the cartel would lower the prices for cinchona bark even further. Therefore, under active support from Van Leersum, who stimulated the planters to become less dependent on the

[29] Maat 2001, 69. In regard to the field station, see Schoor 2012, 43-45.

[30] According to Andrew Goss "Science and government were more closely intertwined than they had ever been before in the Netherlands East Indies." Goss 2011, 91.

[31] Maat 2001, 78.

[32] Maat 2010, 327.

[33] Andrew Goss has pinpointed the role of the GCE directors as 'protector'. Goss 2014, 12.

[34] *Jaarverslagen Gouvernements Kina-onderneming over het jaar 1896-1910*, Item L 2050, Colonial collection (KIT), Leiden University Library and Missive M. Greshoff to the Minister of Colonies, 2 juli 1901, Verbaal no. 30, 10 juli 1901, file 63, Archief Ministerie van Koloniën, Openbaar, 1900-1953, Nationaal Archief, Den Haag.

quinine industry and who provided some technical information, several individual planters began to experiment with the quinine sulphate extraction on their plantations.[35] However, after realizing that the production of the semi-finished product, quinine sulphate, required a certain degree of scientific and technological expertise they did not have as individuals, a group of 18 to 20 planters decided to cooperate. In 1895, they asked Van Leersum to become their spokesman for seeking support from the colonial government for the construction of a quinine sulphate factory in the city of Bandung. The result of this rather unique form of cooperation and organization amongst the cinchona planters was the establishment in 1896 of the cooperative Bandoengsche Kininefabriek (BKF).[36]

The Netherlands-based network of traders, brokers and chemists (1886-1900)

The first cargo of cinchona bark to arrive from the Netherlands Indies in Amsterdam harbour was a government-produced batch of 450 kilograms, exported and sold by the Netherlands Trading Association in 1869. From 1876 onwards, the first small consignments of privately produced cinchona were exported and only after 1882 did private exports begin to surpass government exports.[37] Whereas the government cinchona bark was consigned to the Netherlands Trading Association, and henceforth traded on the Amsterdam market, this was not exclusively the case for private cinchona bark. British brokers and trade agents were advertising in the Netherlands Indies to convince the cinchona planters to sell their product on the main European cinchona market in London. In 1885, approximately 80.000 kilograms (one fifth of the total production) of cinchona bark from the

[35] *Jaarverslagen Gouvernements Kina-onderneming over het jaar 1890-1899*, Item L 2050, Colonial collection (KIT), Leiden University Library. See for a more in-depth account of Van Leersum's work on trying to build a quinine factory in the Netherlands Indies, Goss 2014,12-13.

[36] According to the former director of the GCE, Mathieu Kerbosch (1915-1936), "the cinchona planter is much more inclined to the idea of free market than organisation." M. Kerbosch, 'Nota betreffende de kina-situatie, behoorende bij het schrijven van den dircteur der Gouvernements Kina-onderneming dd. 13 januari 1927 No. 25 aan den directeur van Landbouw, Nijverheid en Handel te Buitenzorg. No. 98 Kerbosch collection, KITLV, Leiden.

[37] Wielen 1903.

Netherlands Indies were sold in London where most of the European quinine manufactures bought their raw material.[38]

In order to stimulate more cinchona planters to offer their barks for sale in Amsterdam, Gustav Briegleb (a broker in colonial products) and Van Heeckeren & Co and Dusseldorp & Co. (trading companies) founded the Cinchona Establishment (*Kina-etablissement*) in 1886.[39] Other trading companies such as the Netherlands Trading Association followed suit. Up until 1886, cargos of bark were scattered across warehouses in Amsterdam, which lacked the facilities to conduct proper chemical analysis to determine the value of the product on auction. The primary goal of the Cinchona Establishment was to ensure a viable trustworthy and competitive market by centralizing cinchona bark storage and trade and create laboratory quality control.[40] For this purpose, the founders of the Cinchona Establishment contracted with the private laboratory, Moens, van der Sleen and Hekmeyer, in Haarlem, The Netherlands. Established in 1882 by the former director of the GCE Bernelot Moens (1837-1885), this laboratory was already performing chemical analyses for the cinchona planters in the Netherlands Indies to determine the quinine sulphate value of their cinchona bark cargos.[41]

Cinchona traders and brokers, empowered by laboratory's involvement, advertised a high-quality cinchona product to their customers, the German pharmaceutical industry. The Cinchona Establishment relied on chemical analysis to distinguish its own 'superior' Dutch bark with a high quinine sulphate content (the laboratory-conditioned *Cinchona Ledgeriana*) from the 'inferior' bark with a low quinine sulphate content (*Cinchona Succirubra*) from British India and Ceylon, which traded on the London market. Thus, the Dutch traders successfully anticipated the German pharmaceutical industry's growing demand for scientifically certified competitive high-quality raw materials. By 1901, more than six (6) million

[38] Wielen 1903 and *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*. (Amsterdam: Unpublished report). Brocacef Archief, Maarssen.

[39] Wichers Hoet 1929, 170-171.

[40] Wielen 1903 and Groothoff 1925, 108-109.

[41] Wielen 1903 and Gorkum 1886, 126-128. See also Vledder, Houwaart and Homburg 1999.

kilograms of cinchona bark were traded on the Amsterdam market making this the largest market for cinchona bark in the world.[42]

Table 5: The main Dutch group of members of the *Vereeniging ter Bevordering van de Belangen der Kinacultuur* (Kinavera), 1894.[43]

Name Firm/member	Type of enterprise
Van Heeckeren & Co.	Trading company
P. Brusse	Broker
Crone & Co.	Trading company
W.F. Koppenschaar	Chemist
D.C.&M. Watering & Co.	Trading company
J. de Ligt	Broker
O.W.G. Briegleb	Broker
Dr. Salzmann	Technical director of the ACF
J.L. Davids	Broker
Th.L.J. Pex	Broker
J.J. Willinga	Manager of the Cinchona establishment
Pharm. Handels-Vereeniging	Manufacturer
J.M.W. van Dusseldorp & Co.	Trading company

The founding of the Cinchona Establishment created a Netherlands-based cinchona network of traders, brokers and chemists with diverse capabilities and expertise. Some of these members were not only active in the cinchona trade, but also in production. Briegleb and J.M.W. Dusseldorp (the director and founder of the trading company Dusseldorp & Co.), for example, also had invested capital and were part of the management of cinchona joint ventures.[44] In contrary to most of the planters in the Netherlands Indies, these trading companies and brokers were able to cooperate more easily during the late nineteenth century. In 1894, these same traders and brokers founded the Amsterdam based *Vereeniging ter Bevordering*

[42] Wielen 1903. See also, Ziegler 2003, 133.

[43] Vereeniging ter Bevordering van de belangen der Kinacultuur*, Notulen Tweede Algemeene Vergadering dd. 12 september 1894* (Amsterdam: J.H. de Bussy, 1894), Colonial collection (KIT), Leiden University Library.

[44] *Handboek voor cultuur- en handelsondernemingen* (1888).

van de Belangen der Kinacultuur (Association for the Advancement of the Interests of the Cinchona Cultivation, or better known as Kinavera) (table 5), strengthening the global cinchona network.[45] Whereas the Cinchona Establishment became an obligatory point of passage for trading high-quality raw and semi-finished products, the GCE back in the Netherlands Indies became the nodal point in the production network of high-quality cinchona. In contexts of both trading and production, chemical-laboratory analysis played an important role in connecting and reifying the networks that would gradually grow into one unified transoceanic network.

The international quinine industry and the establishment of the first pharmaceutical cartel

I have shown how the Netherlands Indies' cinchona cultivation developed in relation to the demands for a high-quality and standardized raw material for quinine medicine production by the European pharmaceutical industry. This emphasis on high-quality quinine medicines was the result of a competitive battle between producers of patent medicines and a rising 'ethical' pharmaceutical industry. By the end of the nineteenth century, the European and American medical markets were overrun by a variety of patent medicines produced by a growing number of manufacturers and laboratories that had shifted to mass production of medicines.[46] The rapid growth of this patent-medicine industry (so-called nostrum-makers) and unrestrained marketing resulted in severe criticism from the medical profession, who characterized these medicines as threats to society and public health and threatened to undermine the emerging pharmaceutical industry. So, 'ethical' pharmaceutical companies successfully distinguished themselves from the producers of patent medicines by creating a trustworthy scientific image of drug innovation, drug standards and medical progress. To ensure safety and efficacy, these companies created in-house laboratories where high-quality medicines were developed and tested and these required the best raw materials.[47] The German pharmaceutical industry, which by

[45] Vereeniging ter Bevordering van de belangen der Kinacultuur*, Notulen Tweede Algemeene Vergadering dd. 12 september 1894* (Amsterdam: J.H. de Bussy, 1894), Colonial collection (KIT), Leiden University Library.

[46] Huisman 2002, 217 and Wimmer 1992.

[47] Roersch van der Hoogte and Pieters 2013, 102-103. For the rise of the pharmaceutical industry, see amongst others Liebenau, Higby and Stroud 1990, Liebenau 1987 and Swann 1988.

this time had grown into the most important and largest industry of its kind in Europe, was keen on creating in-house laboratories in order to produce drug compounds with higher purity than their European rivals.[48]

As mentioned, since the isolation of quinine in 1820, the international scientific community, including physicians, pharmacists and chemists, had been tackling the question of the therapeutic qualities of quinine as an anti-febrifuge in comparison to the other so-called side-alkaloids of the cinchona tree. In the previous chapter, I have shown how from the mid-nineteenth century on, medical professionals preferred to prescribe pure quinine drug preparations. The German pharmaceutical industry took the doctors' preferences to heart and their chemists began to focus attention on the purification and standardization of quinine sulphate as an important semi-finished product for quinine medicines. During the 1880s and 1890s, laboratory research became an integral part in standardizing the production process in the Germany, with a strong emphasis on enhancing the quality standards of the final and semi-finished products. As such, the German pharmaceutical industry developed chemical expertise for quinine sulphate extraction and positioned itself as the most scientifically and technologically advanced, and hence powerful, industry in the worldwide production and distribution of quinine medicines.

By the 1880s, however, prices for both quinine sulphates (see figure 3) and quinine medicines began to decline rapidly. The growing supply of cinchona bark from Asia resulted in a highly speculative market in which entrepreneurs saw quinine production as a quick way to make money. In the 1880s, many small quinine factories across Europe were established, bringing down the prices in the entire product chain.[49] On the one hand, this made the medicine widely available throughout the North Atlantic basin. Before the price crises of the 1880s, quinine medicines had been relatively expensive and available primarily to wealthy patients.[50] On the other hand, and despite the fact that the worldwide quinine consumption increased from an estimated 72.000 kilograms in 1872 to an estimated 300.000 kilograms a year in 1894, supply exceeded demand and

[48] Burhop 2008 and Wimmer 1994.

[49] Gorkum 1886, 133, Ziegler 2003, 130-131and Webb 2009, 113.

[50] Webb 2009, 114. In the Netherlands, a kilogram of quinine sulphate was sold for nearly 400 guilders in 1875, while by the mid-1880s the price had declined to only 20 guilders for a kilogram. Verhave 1995, 253.

undermined prices.[51] As mentioned earlier, the demand for quinine, in contrast to other (colonial) commodities was limited to its singular use as medicine. This meant that there was a limited demand for it, in contrast, for example with sugar. As such, the balance between the supply of the raw material and the demand of the final product was quite delicate, which meant that the overproduction of cinchona bark of the 1880s disrupted this delicate balance between supply and demand, resulting in the rapid decline of the prices. The German quinine manufacturers thus turned to the formation of the first international pharmaceutical cartel as an instrument to restore and hence control this delicately balanced product chain.

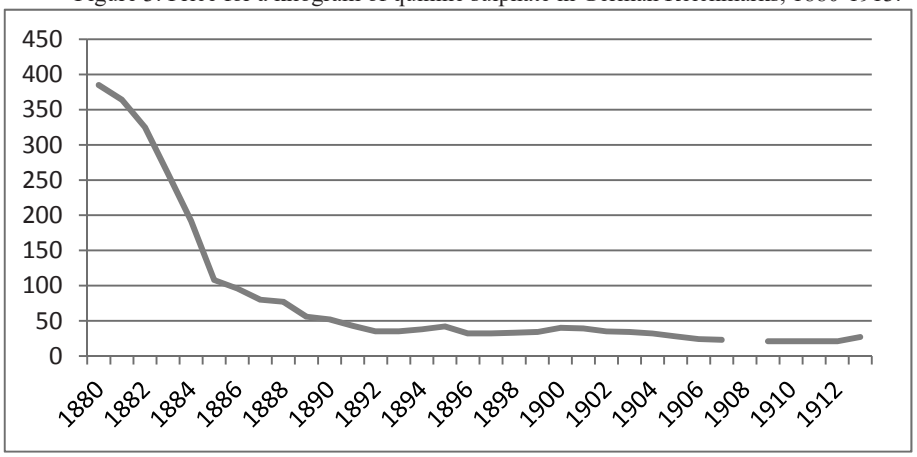
Until the 1880s, a dozen companies were involved in the production and distribution of these antimalarial substances; however, due to the price crisis, a process of concentration took place and three companies emerged as the largest producers of quinine sulphate and quinine medicines: Verenigte Chininefabriken Zimmer & Co., C.F. Boehringer & Söhne and the Chininfabrik Braunschweig Buchler & Co.[52] During the 1880s, several talks were held between these three companies in which interests gradually joined, "opening the door for the creation of the quinine cartel."[53] To avoid further declining prices for both quinine sulphate and quinine medicines and "to bring order on the quinine market," these three German companies opted for price stability and in 1893, they joined in a private price agreement, setting fixed sales prices for quinine.[54] In that same year, the Amsterdamsche Chininefabriek (ACF) joined the private agreement and one year later, in 1894, the British quinine manufacturer Howards and Sons Ltd and the French company Société du Traitment des Quinquinas, joined the price agreement, creating as such the first international quinine cartel (table 6). The cartel would be administrated by the Deutsche Gold- und Silber- Scheideanstalt, who had owned the quinine factory Auerbach but had sold it to Boerhinger in 1891 in exchange for more and better cooperation within the German quinine industry.[55] Under the administration of the Deutsche Gold- und Silber- Scheideanstalt, prices slowly

[51] Groothoff 1925, 113.
[52] Ziegler 2003, 90-91.
[53] Buchler 1958, 106.
[54] This quote is from the former director of the German quinine manufacturer Buchler & Co. Walter Buchler, who described the situation by the end of the nineteenth century in 1958. Buchler 1958 , 105.
[55] Buchler 1958, 105-106.

increased from 17,50 guilders a kilogram in 1893 to 22,50 guilders a kilogram in 1894.[56] In addition, all parties were convinced that this move would also create countervailing power against the planters' production monopoly of cinchona bark in the Netherlands Indies.[57]

The objective of this first international pharmaceutical cartel, extended in 1907 with four (official) members and two unofficial new members (table 7), was to stabilize the quinine sulphate and quinine medicine prices and restore the delicate balance in the product chain from raw material to final product.[58] This meant that another important objective of the cartel was to achieve control over the production and distribution of cinchona bark in response to the dominance of the cinchona production and trade by the Dutch network of planters, traders and brokers. By adapting high-quality standards on the raw material and the chemical analysis to determine the quality of the cinchona bark, the quinine manufacturers and foremost the German companies were in a position to strongly determine the outcomes of the cinchona auctions and the product prices. [59]

Figure 3: Price for a kilogram of quinine sulphate in German Reichmarks, 1880-1913.[60]



[56] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*.(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 17.
[57] Ziegler 2003, 133.
[58] Burkert 1990 and Ziegler 2003, 133-134.
[59] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*.(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 23 and Homan van der Heide 1960.
[60] Dethloff 1944.

Table 6: The first international pharmaceutical cartel: the quinine cartel of 1894[61]

Company	*Location*
C.F. Boehringer & Söhne	Mannheim, Germany
Verenigte Chininefabriken Zimmer & Co.	Frankfurt a/m, Germany
Chininfabrik Braunschweig Buchler & Co.	Braunschweig, Germany
Amsterdamsche Chininefabriek	Amsterdam, The Netherlands
Société du Traitement des Quinquinas	Paris, France
Howards & Son	London, Great Britain

Table 7: The quinine cartel in 1907[62]

Company	Location
C.F. Boehringer & Söhne	Mannheim, Germany
Verenigte Chininefabriken Zimmer & Co.	Frankfurt a/m, Germany
Chininfabrik Braunschweig Buchler & Co.	Braunschweig, Germany
Amsterdamsche Chininefabriek	Amsterdam, The Netherlands
Société du Traitement des Quinquinas	Paris, France
Howards & Son	London, Great Britain
Charles Buchet & Cie, Pharmacie Centrale de France	Paris, France
Pointet & Girard	Paris, France
A. Taillandier	Argentueil (Seine & Oise), France
Nederlandsche Kininefabriek	Maarssen, The Netherlands
Unofficial members: Powers & Weightman Rosengarten & Co. McKesson & Robbins	 Philadelphia, United States of America Brooklyn, United States of America

The GCE laboratory, the colonial government and growing cooperation within the cinchona network (1900-1910)

The planters in the Netherlands Indies, supported by the director of the GCE, were convinced that the global problem of cinchona and quinine

[61] Geschiedenis *der N.V. Amsterdamsche Chininefabriek 1881-1940.*(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 17, Buchler 1958, 106 and Ziegler 2003, 133-134.
[62] Geschiedenis *der N.V. Amsterdamsche Chininefabriek 1881-1940.*(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 27.

overproduction was the result of deliberate speculation by the quinine industry and the use of sub-standard chemical analyses to determine prices.[63] They argued that the chemical analyses conducted by the quinine manufacturers, and by the trading network in Amsterdam, differed considerably from those conducted by the GCE's laboratory.[64] By blindly accepting quinine-sulphate analyses that indicated lower quality of cinchona barks and hence payment of the lower prices, the planters accused the traders and brokers in Amsterdam (with whom the planters cooperated to sell their product), of being the 'enemy' and working for the (German) quinine industry instead of for the cinchona planters.[65] The Amsterdam traders and brokers, however, blamed overproduction and the irresponsible way the planters in the Netherlands Indies exported their product without regard to the markets' surplus.[66] In addition, Dutch chemists questioned the quality of the chemical analysis conducted by the GCE laboratory.[67] It was the colonial government's involvement in creating a separate quinine sulphate market in the Netherlands Indies and the improvement of the GCE laboratory's technical capabilities that eventually diminished the distrust and gradually made way for cooperation and the emergence of a more stable colonial cinchona network across the Dutch empire.

In 1899, the colonial government organised a separate quinine sulphate market in the city of Batavia (today known as Jakarta), after active lobbying by the GCE director and BKF management. Just like the founding of the BKF, the market was a response to the formation of the international quinine cartel in 1894. As mentioned earlier, the cartel enforced control over the cinchona auctions in Amsterdam and hence cinchona prices. The objective of the Batavia market was twofold. First, it was to create an alternative profitable outlet for the BKF´s quinine sulphate product outside the cartel-controlled cinchona bark markets. Second, it was to offer planters a better price for their cinchona bark product, so they would sell their bark to the BKF instead of exporting it to the cartel-

[63] Gorkum 1886, 130.

[64] Maurenbrecher 1903a and Maurenbrecher 1903b. See also Goss 2014, 11.

[65] Maurenbrecher 1903b.

[66] Brusse 1896 and Vereeniging ter Bevordering van de belangen der Kinacultuur 1895.

[67] "Missive M. Greshoff to the Minister of Colonies," 2 juli 1901, Verbaal no. 30, 10 juli 1901, file 63, Archief Ministerie van Koloniën, Openbaar, 1900-1953, Nationaal Archief, Den Haag.

controlled Amsterdam market. Although, the Batavia market was organised by the colonial government, the daily management of trading and selling was outsourced to the private trading company Tiedeman & Van Kerchem. This company had its headquarters in Batavia, but also held offices in Amsterdam and maintained close relationships with other trading companies in the Netherlands.[68] The BKF produced the quinine sulphate and after the GCE laboratory had analysed the quality, it was traded and sold by Tiedeman & Van Kerchem. In the following decade, the quinine sulphate from the Batavian market attracted various transpacific trading companies, including North American pharmaceutical companies, and Americans became the most significant buyers.[69]

The combination of the BKF's production capacities and the opening up of a new transpacific quinine sulphate market resulted in less cinchona bark being exported to Europe. Thus, prices in Europe began to rise once again by the turn of the century.[70] At the same time, in response to the strong competition of the alternative market in Batavia, the cinchona traders in Amsterdam started to offer better trading and selling contracts to the planters in the Netherlands Indies. This in turn encouraged cooperation between cinchona planters and traders (planters earned more trust and confidence in their interaction with the traders) and brought more stability to an emerging cinchona colonial network. Another development, closely linked to the establishment of the Batavia quinine market (and also the BKF), was the position of the GCE laboratory, which also increased network stability.

The GCE had positioned itself as the scientific centre for the constant improvement of a high-quality and standardized cinchona product. For example, the laboratory was used to conduct so-called cultivation analysis (*cultuur-analyse*) regarding research questions of how the quinine sulphate content developed in regard to soil, climate and other cultivation conditions. During the 1890s, in line with the rise of the GCE as centre of the cinchona cultivation, Pieter van Leersum also began to conduct so-called trade analyses (*handels-analyse*) to determine the

[68] Tiedeman & van Kerchem, for example, did business with the Amsterdam-based trading company, Van Heekeren & Co., one of the founders of the Cinchona Establishment. See Wichers Hoet 1929, 170.
[69] Seely 1901.
[70] Cross 1924.

quinine sulphate content of the commercial cinchona barks.[71] As mentioned, these trade analyses were considered to have less technological quality compared to those conducted in European laboratories. In 1901, to decide if such trade analysis should be conducted in the Netherlands Indies (at the GCE) or only in the Netherlands, the Ministry of Colonies sought advice from the pharmacist and expert on colonial export crops, Maurits Greshoff. Although Greshoff was of the opinion that the analysis should be conducted in the Netherlands (due to the circumstances of transportation, the tropical climate conditions in the colony, and the higher level of scientific-technological capabilities of laboratories linked to the Amsterdam market), he advised that the trade analysis also should be conducted by the GCE laboratory. Greshoff stated, "Apparently the analysis of barks in the Netherlands Indies provides the planters with a certain feeling of security."[72]

Thus, the GCE was granted the right to continue cinchona trade analyses and address the issue of the lack of technical capabilities. By 1903, the new laboratory was equipped according "to the present chemical, botanical and zoological standards," which in the words of Van Leersum "made an end to the strained character this establishment had to undergo."[73] In the following years, more and more planters began to send their commercial samples to the GCE laboratory before sending their cinchona bark to Europe.[74] The planters had to pay the GCE a small fee for each chemical analysis. This was symbolic of a growing commitment of the planters to the GCE, and more importantly positioned the GCE laboratory as a central institution in the emerging cinchona production and trade network across the Dutch empire. This position was further strengthened by a growing exchange of knowledge and samples between the GCE laboratory and the private laboratories in Amsterdam. The overseas knowledge exchange induced a standardization of chemical analysis methods and measurements, which in turn helped to foster the stability of the cinchona production and trade network.

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[71] *Jaarverslagen Gouvernements Kina-onderneming over het jaar 1892-1899*, L 2050, Colonial collection (KIT), Leiden University Library.

[72] "Missive M. Greshoff to the Minister of Colonies," 2 juli 1901, Verbaal no. 30, 10 juli 1901, file 63, Archief Ministerie van Koloniën, Openbaar, 1900-1953, Nationaal Archief, Den Haag.

[73] Jaarverslagen Gouvernements Kina-onderneming over het jaar 1903, Item L 2050, Colonial collection (KIT), Leiden University Library.

[74] Jaarverslagen *Gouvernements Kina-onderneming over het jaar 1903-1911*, Item L 2050, Colonial collection (KIT), Leiden University Library.

Cooperation within the emerging cinchona network was further stimulated by the colonial government's growing involvement in the private plantation economy. In 1910, under the energetic directorship of Lovink, the *Nederlandsch Indies Vereeniging ter bevordering van de belangen der Kina-Cultuur* (Netherlands Indies Association for the Advancement of the Interests of the Cinchona Cultivation, or better known as N.I. Kinavera) was established. This was the first organization in the Netherlands Indies that achieved formal cooperation among the majority of the cinchona planters, in that sense that understanding was reached for a more singular policy in regard to production and export of cinchona.[75] Lovink believed that "only a healthy cooperation" could result in a satisfactory solution for the growing price crisis and would also help to avoid the destruction of the capital invested in the cinchona cultivation since the mid-nineteenth century by the colonial government. Therefore, he urged for a closer collaboration between the two cinchona associations (the Netherlands Indies Kinavera and the Kinavera in Amsterdam).

Stimulated by the involvement of the director of the Department of Agriculture, by 1910, a more intertwined and stronger cinchona network was formed in which planters, trading companies, state officials and (state-sponsored) scientists cooperated more intensely than a decade earlier throughout the Dutch empire. This concentration also resulted in a changing relationship with the quinine manufacturers. Given the Dutch worldwide dominance of the cinchona production and trade, the international quinine industry was obliged to buy most of their raw material at one of ten annual auctions held at an auction house, the "Brakke Grond," in the centre of Amsterdam.[76] In other words, the international quinine industry became dependent on the Dutch cinchona production and trading network for their raw material.

The German-led international quinine cartel, established in 1894, sought to challenge the Dutch dominance of cinchona bark production and trade. As mentioned earlier, German pharmaceutical companies demanded high-quality raw materials and as such determined the outcome of the cinchona auctions and the

[75] Notulen der op 16 augustus 1910 in een der lokalen der handelsvereeniging te Batavia gehouden vergadering van belanghebbenden bij de kinacultuur in Nederlandsch-Indië (Weltevreden: Drukkerij van het Departement van Landbouw, 1910). Colonial collection (KIT), Leiden University Library.

[76] Homan van der Heide 1960 and Heuschen 1998.

sales price. The Dutch, however, thought of a way to circumvent this and started their own quinine sulphate production and distribution by establishing the aforementioned BKF, and the Nederlandsche Kininefabriek (NKF). The emergence of a Dutch quinine industry by the first decade of the twentieth century, together with the strengthening of the Dutch cinchona production and trading network proved to be essential factors in shifting the power of control over cinchona bark, quinine sulphate and quinine medicines production and distribution chain from the German pharmaceutical industry to the Dutch colonial cinchona-quinine network of producers and traders.

The emergence of a Dutch quinine industry, 1896-1910

Through targeted investment in product development and innovative production processes, a group of three German pharmaceutical firms came to dominate the international quinine industry at the end of the nineteenth century. By the early twentieth century, however, they were challenged by two Dutch companies, the Netherlands Indies-based BKF and the Netherlands-based NKF. In contrast, a third Dutch quinine factory, the Amsterdamsche Chininefabriek (ACF) had become highly dependent from the German pharmaceutical industry in regard to scientific-technological knowledge and financial support. In this regard, the ACF was not able to take advantage of easy access to the raw material as did the other two Dutch-controlled factories.

The N.V. Amsterdamsche Chininefabriek, 1881-1910

In 1880, with the cinchona culture in the Netherlands Indies still in its infancy, Johann Gerard Wilhelm Sieger (1856-1942) contacted his father-in-law, A.H.J. Diemont, with the idea of establishing a quinine factory. Sieger, who had learned the quinine business as a sales agent for the German company Zimmer & Co., in Rumania, Japan and China during the late 1870s, saw great opportunities for the production of quinine sulphate.[77] Diemont saw the same commercial opportunities as his son-in-law and was further influenced by nationalistic pride. He did not believe that the production of quinine sulphate should be left only to

[77] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*. (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 1.

foreign companies.[78] Diemont was probably well aware that the Netherlands Indies' cinchona culture could benefit from this venture. However, in 1881, the market for cinchona barks was still controlled by the British trading houses through the London market. So, until the opening of the Cinchona Establishment in 1886, the ACF was bound to buy the bulk of its raw material at the London bark auctions.[79]

In regard to the technical production site for quinine sulphate, Sieger and Diemont contracted the German Theodor Ruth, a former employee of Zimmer & Co. and an experienced chemist, to manage the factory layout and initiate the production process.[80] Furthermore, a chemical analyst had to be hired to conduct analyses on the quality of the final quinine sulphate product. The first candidate to fill this position was the director of the GCE, Bernelot Moens. He was offered the position as chemical analyst with the condition that he would have his own laboratory outside the factory premises and a royal payment. Moens, who had returned to the Netherlands in 1882, rejected the offer preferring his good relationships with the cinchona planters over this position within the ACF.[81] The second candidate was another well-known cinchona expert, and also a former employee of the GCE, the pharmacist Dr. J.E. de Vrij. He accepted the offer and was willing to analyse the quality of the quinine sulphate produced by the ACF in his own private laboratory.[82]

In 1881, when Sieger and Diemont established the ACF, prices for quinine sulphate were still high. However, a significant drop in prices over the next years

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[78] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*. (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 2.

[79] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*. (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 5.

[80] Contracting a German chemist was normal procedure in the late nineteenth century in the Dutch industry. In Germany it had become normal for universities to educate chemists to work in the industry, whereas in the Netherlands this was still uncommon. Most Dutch company owners therefore contracted German chemists to work in their companies. Homburg 2003, 13 and Homburg, Rip and Small 2000, 298.

[81] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*. (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 6

[82] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*. (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 6-7 and Algera 1994. See also Vledder, Houwaart and Homburg 1999.

proved disastrous for the ACF. In a short time, the factory lost more than half its initial capital of one million guilders. Furthermore, the ACF struggled to sell its product and keep the quality of the final quinine sulphate product on a level that corresponded with the guiding pharmacopeia and the high-quality product of the German industry. By 1886, half the ACF shares had become worthless and the company was sold at a public auction. With private investments, Sieger was able to buy the entire company back and start a new joint venture under the same name.[83] To try to resolve the quality issues of the quinine sulphate product, the ACF contacted the largest quinine manufacturer, C.F. Boehringer in Mannheim, Germany. The result was the signing of a 15-year contract in 1886, in which Boehringer became responsible for the technical process of quinine sulphate extraction at the ACF factory. By this time, Boehringer had worked with the latest extraction techniques in their own factory and the ACF management hoped the same technical knowledge would be applied in Amsterdam.

However, over the next few years, Boehringer tried to transfer the entire production process away from Amsterdam to their factory in Mannheim, thus making the ACF into just a packaging and distribution centre. It was only because of the strong interference of Sieger and Johan de Vrij, who in 1886 had become one of the supervisory board members, that the production process remained in Amsterdam.[84] After much pressure from the board, in 1892, Boehringer finally installed a new and more technically advanced extraction machine at the ACF. This increased the possibility of a high-quality product. In addition, with the founding of the 1894 cartel and the growing cinchona market in Amsterdam, prospects looked good for the ACF by the end of the century. In 1902, the contract with Boehringer ended and in 1905 the Dutch chemist Pieter Hajonides van der Meulen was appointed as the new technical director of the company. Under the technical leadership of Hajonides van der Meulen, who remained technical director of the ACF until 1935, the production capacity of the ACF was improved and 'emancipated' from German technical assistance.[85] Hajonides van der Meulen was

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[83] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940.* (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 11-12 and Wielen 1903, 922-923.

[84] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940.* (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 13 and Algera 1994, 84-85.

[85] *Geschiedenis* der *N.V. Amsterdamsche Chininefabriek 1881-1940.* (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 22.

part of a first generation of chemists who were specifically trained to work in the Dutch industry due to their studies at the Polytechnic School of Delft.[86]

During a short period of rising prices in the early 1900s, the ACF management was convinced it could act as an independent manufacturer. Thus, in 1906, the ACF left the international quinine cartel and its director Sieger travelled to the United States and England to open up new markets that were not controlled by the cartel. Contracts with the governments of Russia and Italy were signed; however, by 1907, the ACF had re-entered the cartel.[87] Once more, declining prices and strong competition had forced the ACF into the hands of German industry. This time, however, the ACF was not dependent on German technical knowledge, but rather dependent on their financial support. In 1907, after selling the majority of its shares to the German company Deutsche Gold- und Silber-Scheideanstalt, the ACF became part of the German group within the international quinine cartel.

The Bandoengsche Kininefabriek, 1896-1910

The establishment and development of the BKF can be regarded as a central factor in the shift from the German pharmaceutical industry's control of the international cartel to Dutch cinchona and quinine producers and traders. As mentioned earlier, a group of cinchona planters drafted the plan for a 'planter's quinine factory' during the mid-1890s, to ensure better prices for the product of cinchona cultivation in the Netherlands Indies. In the years prior to the establishment of the BKF, some cinchona planters experimented with extracting quinine sulphate. They had hoped to become less dependent on European industry and put "the cultivation of the raw material and the processing of the final trade product – just as in the sugar and tea industry – in the hands of the cinchona cultivation."[88] However, the challenges of their geographic location for supplying chemicals and material for the extraction process (cinchona plantations were located in the hills with an average altitude of 1500 meters), the humidity of the climate, and the highly standardized demands for quality and efficacy of the

[86] Homburg, Rip and Small 2000, 305.

[87] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*. (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 23.

[88] Citation of the planter A. Massink in a memo send by the Governor-General to the Minister of Colonies, 26 July 1896, no. 1298/6. Verbaal 9 oktober 1896, no. 56 Item 5091, Archief Ministerie van Koloniën, 1851-1900, Nationaal Archief, Den Haag.

product made these activities quite costly.[89] Thus, the extraction process required a cooperative effort among various planters, scientific-technical input from the GCE and government support to establish a factory capable of competing with the leading German manufacturers.

Although it remains unclear who exactly invested the capital for the establishment of the BKF, F.L. Seely, who worked for the North American pharmaceutical and wholesale company Paris Medicine & Co. and who visited the factory in 1900, stated clearly that the factory was "largely owned by planters themselves."[90] The daily management of the factory was placed in the hands of the lawyer Baron C.W. van Heeckeren, from the city of Semarang and the former cinchona planter J.H. van Prehn, who previously had experimented with quinine sulphate extraction on his own plantation.[91] In the early years, however, the BKF struggled to deliver a high-quality quinine sulphate product due to lack of capable chemists. Its technical director, van Prehn, for example, worked with a flawed extraction method thus losing more than 30% of the quinine sulphate content during the extraction process. This caused growing difficulties between Van Prehn and the other members of the board of directors, foremost Van Heeckeren.[92] In early 1898, a sample of its product was chemically assessed by a private laboratory in Amsterdam, which concluded that the product "was not lovely white, but heavy, and in regard to its purity stood behind the product of the European industry."[93] To ensure the viability of the factory, it became of utter importance to improve the quinine sulphate product.

In 1898, van Prehn resigned due to bad health and was succeeded by J. Smit Sibenga, who like van Prehn had previously worked on the estate Langen Ardjo. Smit Sibinga only lasted for two years and in 1900, the BKF management appointed a new technical director, the young chemist Arent Roelf van Linge (1870-1934). Just like Hajonides van der Meulen of the ACF, this young and

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[89] Homan van der Heide 1960.

[90] Seely 1901.

[91] *Jaarverslag Bandoengsche Kininefabriek 1898*, Item L 2655, Colonial collection (KIT), Leiden University Library.

[92] *Jaarverslag Bandoengsche Kininefabriek 1898*, Item L 2655, Colonial collection (KIT), Leiden University Library.

[93] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940.*(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 18.

brilliant chemical engineer was part of a generation of scientists educated at the Polytechnic School of Delft under the guidance of the professor of chemistry, Simon Hoogewerff. The latter had pioneered stronger relationships between industry and academia, in order to stimulate the growth and technical knowledge of Dutch industry.[94] After receiving his doctorate in Basel, Switzerland in 1896, Van Linge left for the Netherlands Indies. He worked for three years "in the hills of Java among tigers and snakes" on the cinchona plantation Pandan Aroem (located in the Bandung region) trying to build a small quinine sulphate extraction facility and practicing his chemical-technical knowledge.[95]

At the BKF, Van Linge "invented and personally supervised the construction of the machinery and apparatus" for a new extraction process which was able to produce a high-quality quinine sulphate product.[96] However, after two years, Van Linge left the BKF and returned to Europe.[97] An important reason for him to leave the colony and the BKF was his bad relationship with the director of the GCE, Pieter van Leersum. In addition to Van Linge's disagreement with Van Leersum's method of extracting quinine from wet bark, he especially disliked the fact that Van Leersum treated the BKF as his own and henceforth tried to implement his own ideas against Van Linge's will. After receiving no support from the general director Van Heeckeren, Van Linge decided to leave the BKF.[98] In 1903, the young pharmacist S. van Velzen Camphuis was appointed as the new technical director. Van Velzen Camphuis continued the work of Van Linge to constantly improve the quinine sulphate extraction process and under his technical directorship the BKF gradually began to increase its production capacity and developed into a competitive factory. By 1905, new machinery was installed in the factory "which could produce quinine, in shape and colour, as asked for by the requirements" and a small laboratory was built for conducting essential chemical

[94] Homburg, Rip and Small 2000, 305. In regard to scientific research in industry and academia in the Netherlands, see Homburg 2003.

[95] Kina-Bureau 1934 and Missouri Botanical Gardens 1931, 20-24.

[96] Seely 1901 and Kina-Bureau 1934.

[97] According to the annual report of the BKF because of health reasons, however, Heuschen mentions the embroiled relationship between Van Linge and Van Leersum, who constantly interfered in the extraction process, and the unwillingness of the director Van Heeckeren to modernize the factory, as reasons for Van Linge to leave. N.V. Bandoengsche kininefabriek 1902 and Heuschen 1998.

[98] Heuschen 1998. and. Homan van der Heide 1960.

analysis in close interaction with the GCE laboratory. In the following years, the laboratory also became central in developing quinine tablets with a sugar coating for distribution in the Netherlands Indies.[99]

The BKF was able to extend its scientific, technological and production capacities during the first decade of the twentieth century. In 1894, the worldwide production of quinine sulphate was estimated to be approximately 300.000 kilograms; by 1914 this had grown to approximately 510.000 kilograms annually.[100] BKF production contributed about ten percent of this total: an average of 40-50.000 kilograms a year (figure 4). Two-thirds of their production was sold at public auctions in Batavia by the trading company Tiedeman & Van Kerchem and shipped to various parts of the world. According to the American Seely, "a great deal of it coming to America."[101] The other part of the annual production (between 14.000 and 18.000 kilograms) was sold to the Netherlands Indies' colonial state. The BKF factory had a continuous income from this fixed-production contract as well as direct access to cinchona bark from surrounding cinchona plantations (also ensuring a lower price because of minimal transportation costs). By 1905, these advantages enabled it to improve its technical capabilities and production capacity.

The BKF positioned itself amongst the leading quinine factories in the world in 1910 with a production level of more than 120.000 kg of quinine sulphate (figure 4) by exploiting direct access to the raw material, connections with the cinchona planters and the GCE and the scientific-technological expertise of its scientists in producing a high-quality and standardized product. In comparison, one of the German manufacturers, Zimmer & Co., produced approximately 50-60.000 kilograms of quinine sulphate in 1909.[102] The BKF, though, was not the only Dutch firm in the market.

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[99] N.V. Bandoengsche kininefabriek 1905 and N.V. Bandoengsche kininefabriek 1906.
[100] Groothoff 1925, 113.
[101] Seely 1901.
[102] Ziegler 2003, 144.

Figure 4: Production of quinine sulphate in kilograms by the Bandoengsche Kininefabriek, 1901-1910.[103]

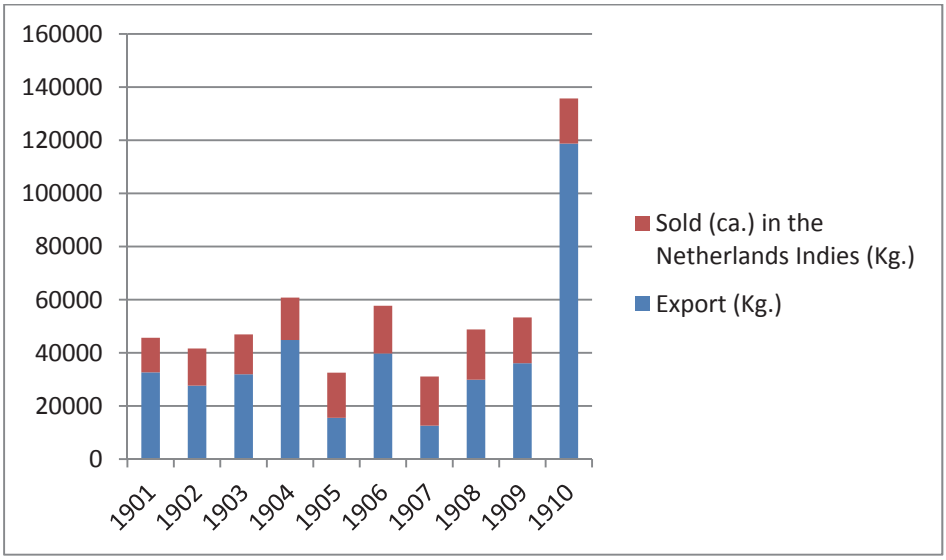

Illustration 6: Dr. A.R. van Linge as technical director of the BKF, approximately 1899-1900.[104]

[103] Dienst der belastingen in Nederlandsch-Indie 1925, Bijlage 4.
[104] Seely 1901.

The Nederlandsche Kininefabriek, 1902-1910

The NKF was founded in 1903-04 in the small town of Maarssen, south of Amsterdam. Just as the BKF had done, the NKF became a strong competitor of the German-led international quinine cartel. Although the NKF was not situated near the cinchona plantations, I will show how its management was creative in gaining access to cinchona bark outside the cartel-regulated auctions. In addition, the NKF was highly successful in building sales markets outside the European markets, dominated by cartel, due to the high quality of its product.

In 1903, one year after Arent Roelf van Linge left the Netherlands Indies, he helped start the NKF. Van Linge's old fellow Delft student, Hendrik van der Woude, had started a small factory specializing in ether and chloroform production and this became the NKF. Under Van Linge's technical management, the factory was reorganised for quinine sulphate production and in 1903 the first small amounts were produced and sold. Van Linge's technical capabilities ensured the production of a high-quality quinine sulphate product, just as had occurred during his colonial years at the BKF.[105] At the same time, Van Linge also guaranteed that his high-quality product found suitable markets. In the Netherlands Indies, Van Linge had befriended F.L. Seely, the North American pharmacist and wholesaler mentioned earlier, and through this friendship, Van Linge came in contact with the British trading house of R.W. Greeff & Co.[106] This trading company had strong connections with the North American pharmaceutical industry, and provided the NKF with the opportunity to sell quinine sulphate bulk product on the exponentially growing American medical market.[107] By the mid-1900s, R.W. Greeff & Co. opened up a special subsidiary in New York for the sale of NKF quinine sulphate and invested capital for improving and extending the NKF's production capacity.[108] As a result, in 1905, the NKF produced almost 30.000 kilograms of quinine and by 1907 production had risen to more than 42.000 kilograms.[109]

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[105] Heuschen 1998 and *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940*.(Amsterdam: Unpublished report). Brocacef Archief, Maarssen.

[106] Seely 1901.

[107] For the American medical market and pharmaceutical industry, see amongst others Liebenau 1987.

[108] Homan van der Heide 1960 and Heuschen 1998, 39.

[109] Homan van der Heide 1960.

The NKF also managed to build its own supply network of cinchona bark, so essential for the production of quinine sulphate. In contrast to the BKF, which was a planter's factory with easy access to raw material, the NKF (in the Netherlands) in principle had to buy its cinchona bark at the auctions of Amsterdam as did all other quinine manufacturers. However, through Van Linge's colonial connections, a contract was signed between NKF and one of the largest traders in cinchona bark, the trading company D.C. & M. Watering & Co.[110] Thus, the NKF had direct access to cinchona bark producers. By the mid-1900s, Van Linge's scientific-technological ability to produce a high-quality product and the NKF's ability to build its own supply and sales network outside the quinine cartel-controlled markets positioned the NKF as a strong competitor to the German-led international quinine cartel. In 1907, the NKF joined the quinine cartel after receiving an offer its management could not refuse. Desperate to have the NKF within the cartel, the Germans offered the NKF the largest individual quota of all the cartel members, making it one of the largest quinine manufacturers in the world. In addition, the NKF's management had successfully negotiated with the Germans to keep their contract with Watering & Co. for a direct supply of cinchona bark and their own distribution channel for quinine sulphate to the United States.[111]

Within a decade, the NKF became one of the leading quinine manufacturers of the world, positioning itself as a successful competitor of the leading German companies within the international quinine cartel. Van Linge had built a small but strong network with an Atlantic distribution chain, direct access to cinchona and a scientific-technological learning base, which was able to compete with the larger German pharmaceutical companies. By the end of the first decade of the twentieth century, the Dutch quinine industry together with the BKF in the Netherlands Indies was established as a major internal competitor to the German quinine industry within the international quinine cartel and cartel-controlled markets.

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[110] Homan van der Heide 1960 and Heuschen 1998, 39.

[111] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940.*(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 28.

The Cinchona Agreement and the establishment of the Cinchona Bureau: the shift in the internal *cartel* balance of *power*

The emergence of a more stable cinchona network around a standardized, quality controlled and laboratory-conditioned cinchona bark product and the development of a strong and competitive Dutch quinine industry across the Dutch empire by the first decade of the twentieth century challenged the dominant position of the German pharmaceutical industry within the cartel. In this section, I will show how the establishment of the American connection in the transoceanic network and the gradual shift in control over the delicate product chain from raw material to final product provided the conditions for the shift in the internal balance of power in the international quinine cartel.

The American connection

As mentioned, the Dutch connection with the American pharmaceutical industry and medical market was a pivotal factor in shifting the internal cartel balance of power from the German pharmaceutical industry to the Dutch cinchona and quinine producers. By the mid-1870s, the American quinine market was dominated by a handful of pharmaceutical companies, notably Rosengarten & Sons and Powers & Weightman from Philadelphia (who merged into Powers & Weightman Rosengarten & Co. in 1905) and the New York-based firm New York Quinine and Chemical Works (owned by the Mc Kesson & Robins pharmaceutical company).[112] In 1879, the U.S. Congress abolished import duties on quinine imported into the United States and opened the door to the European pharmaceutical industry. Suddenly, the American companies had to compete with the more inexpensive and high-quality quinine medicines from the German pharmaceutical industry, which began to flood the American medical market that consumed about 40 per cent of the global quinine production.[113] In the words of Mr. A.C. Robbins, director of the company and quinine manufacturer McKesson & Robbins in the New York Times in 1883: "The action of Congress seems to have been an endeavour to give the final blow to the manufacture of the quinine

[112] McCabe 1874, 393-394, "The Quinine Manufacturers. The Industry alleged to be destroyed in this country." *The New York Times* March 7th 1883 and Spillane 2000, 56-57.
[113] Webb 2009, 113-114.

products in this country."[114] The opening of the American quinine market forced the quinine manufacturers to look for cheaper raw materials and/or semi-finished products to strengthen their position on the American market against the less expensive German products. In this way, the American pharmaceutical companies were attracted by the rise of the two Dutch quinine manufacturers, who could supply cheap but high-quality semi-finished quinine sulphate outside the German-controlled markets.

Situated in Bandung, Indonesia/Netherlands Indies, the BKF was part of a transpacific connection with access to expanding markets like Japan and the United States. With the opening of the Batavia quinine sulphate market, it thus became possible for the American pharmaceutical companies to circumvent the German industry-controlled markets in Europe (e.g. Amsterdam). So, by the turn of the twentieth century, American trading houses were shipping cargos of quinine sulphate from Batavia to New York.[115] In the process, the technical director of the BKF Van Linge became close friends with the American quinine producer Seely who had visited Java as part of a business trip around the world from 1899-1900.[116] One of Seely's interests on Java was to secure quinine sulphate supplies for his father-in-law's company, Paris Medicine & Co. In 1878, the entrepreneur Edwin Wiley Grove had brought the patent medicine 'Grove's Tasteless Chill Tonic,' a bottled quinine mixture that supposedly would have eliminated the bitter taste of quinine, on to the market. Grove built the Paris Medicine Company on the success of this patent quinine medicine. After working for two years at the pharmaceutical company Parke, Davis & Co. as a chemist, Fred Seely moved to the Paris Medicine Company in 1892 and expanded the company together with his father-in-law in the city of St. Louis.[117]

After returning to the Netherlands, Van Linge brought the transpacific connection with him and transformed it into a transatlantic connection and distribution network with the help of the British company Greeff & Co. As

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[114] "The Quinine Manufacturers. The Industry alleged to be destroyed in this country." *The New York Times* March 7th 1883.
[115] Seely 1901.
[116] The Baltimore Industries Archive/Collection in Ashville NC, USA, holds various letters between Van Linge and Seely from the 1920s and early 1930s in which they discuss business and family affairs.
[117] Jackson 1991.

mentioned earlier, Greeff & Co. opened up a special subsidiary office in New York and through this connection the NKF came in direct contact with pharmaceutical companies such as Powers & Weightman Rosengarten & Co. (which by 1927 was acquired by Merck & Co.) and McKesson & Robbins, who bought quinine sulphate in bulk from the NKF for the further production and distribution of quinine medicines on the American market.[118] It was through NKF's American connection that the two American pharmaceutical companies Powers & Weightman Rosengarten & Co. and McKesson & Robbins became unofficial members of the international quinine cartel.[119]

The American connection thus provided the BKF and NKF with an important market for the supply of their product and the opportunity to position themselves as important competitors to the German quinine industry. In events similar to what happened in the cocaine industry at the turn of the twentieth century, the American and Dutch connection gradually challenged the primacy of the German pharmaceutical industry.[120] Moreover, direct access to the American market helped to foster the establishment and maintenance of a transoceanic network of cinchona producers, quinine manufacturers, (colonial) scientists and state officials across the Dutch Empire.[121]

A shift of control in the delicate balance of the product chain, 1910-1913

The rising prices for both cinchona bark and quinine sulphate at the turn of the century, however, had their downside. Between 1900 and 1905, planters and traders once more began to expand their export of cinchona bark to Europe as a result of the higher prices paid for by the quinine-cartel members. In response, prices for cinchona bark began to decline rapidly after 1905.[122] In combination with the low quinine sulphate price offered by the 'outsider' BKF, prices for quinine sulphate and quinine medicines also dropped after 1905 and exports of

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[118] Homan van der Heide 1960, Heuschen 1998 and "Merck and Power-Weightman-Rosengarten Firms Consolidated: Long-Established Houses Act United Under Name of the Former," *Oil, Paint and Drug Reporter* May 16, 1927, p. 21+38C.

[119] Geschiedenis *der N.V. Amsterdamsche Chininefabriek 1881-1940*.(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 27.

[120] Spillane, *Cocaine*, 57.

[121] In regard to a historical analysis on integration within an inter-firm network setting, see amongst others Fruin 2007.

[122] Cross 1924.

quinine medicines by the three German companies declined from 182.300 kilograms in 1907 to 171.500 kilograms in 1909.[123] The emergence of the BKF and NKF and the growing control of the cinchona planters and traders over their product had a significant influence on the delicate balance in the product chain.

By 1910, the Dutch cinchona network, under the steering role of Lovink took the lead in bringing together the cinchona producers and quinine manufacturers to try to restore the balance in the product chain. Similar rapprochements between the cinchona producers and quinine manufacturers had been taking place in 1895 and by the mid-1900s. In 1895, the German quinine manufacturer Herman Buchler (founder of Buchler & Co.) travelled as representative of the quinine cartel to Java with the hope of achieving a form of understanding for cooperation.[124] By the mid-1900s, one of the directors of the trading firm Suermondt & Co. F.H.M. Koch (an importer and owner of cinchona plantations), proposed a plan of cooperation.[125] Both attempts to bring the cinchona producers and quinine manufacturers onto the same page, however, failed. During the years 1911 and 1912, several talks took place between representatives of the Dutch cinchona network (planters and traders) and the international quinine cartel (notable the director of the German company Buchler & Co.) to discuss conditions on how to reform the markets for cinchona bark, quinine sulphate and quinine medicines.[126]

A central aspect of these talks was the dominant position of the Dutch cinchona and quinine industry, illustrating the shift that was taking place in the internal balance of power of the cartel. When in 1911, the German companies rejected a proposal drafted by the planter (and German) Von Winning in cooperation with the director of the German manufacturer Zimmer & Co, with "the goal to improve the cinchona market permanently," cinchona traders responded by "holding firm" during the auctions in Amsterdam.[127] This meant they withheld the product from the market in order to pressure the German

[123] Dethloff 1944, Cross 1924 and Ziegler 2003, 134.
[124] Buchler 1958, 106.
[125] Departement van Landbouw 1910.
[126] Winning 1904, Buchler 1958, 110 and several documents in No. 12 of the Kerbosch collection, KITLV, Leiden.
[127] Winning 1904.

companies to rethink their position by delaying the sales of cinchona bark. At the same time, the Netherlands Indies colonial government, under Lovink, actively participated in restoring the delicate balance. In previous years, the GCE director van Leersum had been working on a plan to establish a second (government) quinine sulphate factory on the premises of the GCE. Lovink, in turn used this plan to pressure the German companies to come to an agreement with the cinchona network.[128] Meanwhile, the BKF was negotiating with the Germans to join the quinine cartel. Desperate to have the BKF included in their cartel, the Germans accepted the BKF with the same stipulations they had given the NKF in 1907, notably a high production quote and maintenance of its direct overseas markets to the United States. The result was that a second strong Dutch quinine manufacturer would join the cartel once an agreement was signed with the cinchona producers.[129]

The Cinchona Agreement and Cinchona Bureau, 1913

In 1913, the Cinchona Agreement was signed and the Cinchona Bureau (*Kina-bureau*) was established. The cinchona network and Dutch quinine industry dominated the details of the agreement. This was illustrated by the Amsterdam location of these final talks, the signatories of the agreement, and the composition of the Bureau's board. Initially, during the first half of 1913, the last round of talks between representatives of the cinchona network (members of the Kinavera board) and the quinine cartel continued at the headquarters of the Netherlands Trading Association in Amsterdam. Present were the representatives of the cinchona producers, directors Vorstelman and Loudon of the two largest cinchona trading companies (D.M. & C. Watering & Co. and Tiedeman & Van Kerchem respectively), C.J.K. van Aalst, director of the Netherlands Trading Association and Van Linge of the NKF and Van Velzen Camphuis of the BKF (who was sent specifically because of his technical and commercial knowledge). The only non-Dutch representative was G. du Bois, director of the Deutsche Gold-und Silber-Scheideanstalt, the representative of the German manufacturers.[130]

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[128] Verbaal 17 maart 1913, no. 18, Item 1024, Archief Ministerie van Koloniën, Openbaar, 1900-1953, Nationaal Archief, Den Haag. See also Goss 2014, 14-15.

[129] 'Aanteekeningen boekje, no. 18' and 'Aanteekeningen boekje, no. 15, No. 12, Kerbosch collection, KITLV, Leiden and Buchler 1958, 110.

[130] *Mededeelingen van het Kina-Bureau*, No. 17, VI (Nov. 1925), Colonial Collection (KIT), Leiden University Library.

On June 12, 1913, these men signed the Cinchona Agreement, representing 95% of all cinchona producers and seven quinine manufacturers (see figure 5). Among these seven manufacturers, none were from the United States or France because the laws in these countries prohibited companies' participation in cartels or price agreements. Whereas the cartel arrangements of 1894 and 1907 were private, the signing of the Cinchona Agreement in 1913 was a public agreement. Formal contracts were signed between the new Cinchona Bureau and these companies for the supply of cinchona bark.[131] The Agreement entailed two central principles. The first was that the quinine cartel members were obliged to buy 515.000 kilograms of quinine sulphate worth cinchona bark a year and only from the cinchona producer's, for a period of five years. This meant the cinchona producers were obliged to reduce their production by approximately 10% to meet this amount. Second, a minimum price was set of five Dutch cents a unit based on a minimum price of 16,50 guilders for a kilogram of quinine sulphate.[132] In contrast to the old administration of the cartel, which was conducted by one company, the Deutsche Gold-und Silber-Scheideanstalt, the new Cinchona Bureau's board included seven men: three representing the cinchona producers, three for the quinine manufacturers and one independent chairman. From these seven men, five were directors of Dutch companies (three cinchona producers and two quinine manufacturers) and only one member was a director of the German quinine manufacturer Buchler & Co. (table 8).

This revised cartel institutionalized the Dutch quinine industry's dominant position, facilitating their ambition of strengthening the transoceanic network, and thereby restoring the delicate balance in the entire product chain.

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[131] The *Kina-overeenkomst 1913*, Item 9007, Archief NHM, Nationaal Archief, Den Haag and M. Kerbosch, "Nota betreffende de Kina-situatie, behoorende bij het schrijven van den directeur der gouvernements kina-onderneming dd. 13 januari 1927, No. 25 aan den directeur van Landbouw, Nijverheid en Handel te Buitenzorg", no. 98, Kerbosch-collection, KITLV, Leiden.

[132] Winning 1904. See also Goss 2014, 15.

Figure 5: The Cinchona Agreement and the various parties involved.[133]

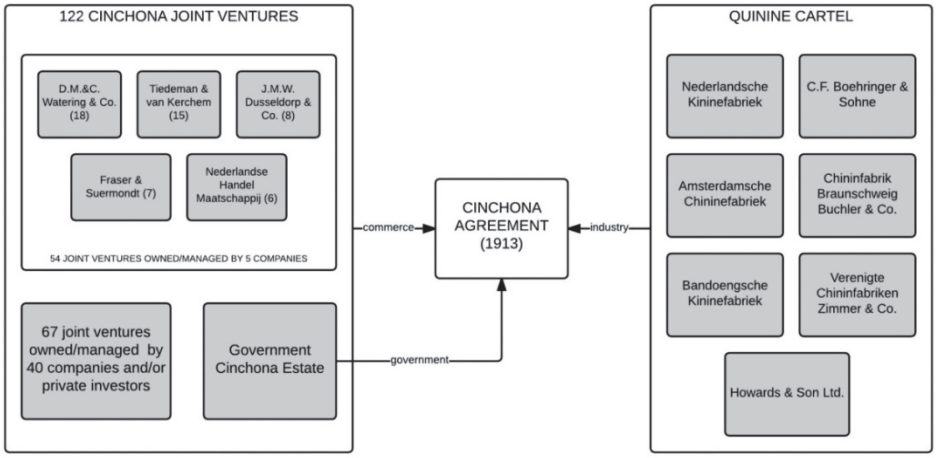

Table 8: The first board of management of the Cinchona Bureau, 1913.[134]

Name	Position and company	Producer or Manufacturer member
W.F. van den Broek	Director of Dusseldorp & Co.	Cinchona Producer
Dr. Walter Buchler	Director of Buchler & Co.	Quinine Manufacturer
Dr. P.H. van der Meulen	Director of the Amsterdamsche Chininefabriek	Quinine Manufacturer
F.H.M. Koch	Director of Suermondt & Co.	Cinchona Producer
L.G. Schalkwijk	Representative of the Bandoengsche Kininefabriek	Quinine Manufacturer
J. Vorstelman	Director of D.M & C. Watering & Co.	Cinchona Producer
Mr. J.W. Ramaer[135]	Lawyer and political broker	Chairman

[133] In comparison to the 1907 quinine cartel, fewer quinine manufacturers joined the new cinchona and quinine cartel, notably the four French manufacturers. However, it remains unclear why this occurred.

[134] Kina-bureau to NHM, 1 November 1913. Item 9007, Archief NHM, Nationaal Archief, Den Haag. List of importers, auction 14 July 1910, No. 75, No. 666 Archief Makelaardij Westerman & Co, Stadsarchief Amsterdam.

The First World War: further strengthening the position of the Dutch within the cartel

The outbreak of the First World War put an abrupt end to a process of internationalization in worldwide business and trade that had taken place since the late nineteenth century. One consequence, as described in this case, was to initiate a process of protectionism in which national governments emphasised self-reliance, stimulating stronger forms of cooperation between enterprises and between government and businesses.[136] In the Netherlands, private and public projects were initiated to stimulate the Dutch economy and industry.[137] For example, in the chemical industry, the war resulted in the founding of the Association of the Netherlands Chemical Industry (*Vereeniging van de Nederlandsche Chemische Industrie VNCI*) in 1918.[138] For the cinchona and quinine businesses, the First World War proved to be a catalyst in strengthening the cooperation between the cinchona producers and the Dutch quinine manufacturers as a result of the isolation of the German pharmaceutical industry. This provided the last factor for the establishment of a 100 per cent Dutch-controlled Cinchona Bureau.

The First World War: the last factor in the internal shift of power

In August 1914, when the First World War began, the Cinchona Agreement had been in place for six months (the actual Agreement started in January 1914). In October 1914, the chairmen of the Cinchona Bureau, Mr. J.W. Ramaer, informed the cinchona producers in the Netherlands Indies of changing circumstances. He explained how the war had disrupted the normal transactions stipulated in the Cinchona Agreement and that due to the lack of chemical supplies for the extraction process and the export difficulties, the foreign quinine manufacturers (foremost the Germans) were not going to be able to buy their usual share of cinchona bark. Ramaer advised the producers to accept the

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[135] Ramaer was also a representative of the Netherlands Indies Sugar Syndicate and of great value as a 'political broker' within the broader colonial business network. Taselaar 1998, 102-108.

[136] Sluyterman 2005, 75-88.

[137] Schot and Rip 2010, 22.

[138] Homburg 2000, 329. One of its founders was W. Sieger, the director of the Amsterdamsche Chininefabriek.

situation, adding that "as soon as these extraordinary circumstances, which justify this reduction, are over the normal purchase will take its course again."[139] These "extraordinary circumstances," however remained in place for the next four years and provided the last factor for the integration of the transoceanic network and for the Dutch cinchona and quinine network to take control of the internal power of the cartel.

During the war, the German pharmaceutical industry became increasingly isolated from access to the raw material and their foreign export markets. The British blockades to curtail German import and export became more effective and at the same time the German imperial government issued export bans for products deemed necessary for military and civilian purposes, including pharmaceuticals.[140] As a result, the German quinine manufacturers were no longer in a position to influence cinchona bark production or trade through the Cinchona Bureau and hence control the international quinine sulphate and quinine medicines markets. The Dutch quinine manufacturers took advantage of this vacuum. They became the largest buyers of cinchona bark and took over the German manufacturers' export markets, making the Dutch the largest producers of quinine sulphate.[141]In 1916, the NKF, BKF and the Dutch government all pressured the Germans to sell their majority shares in the ACF (which the British government saw as a German subsidiary), to the BKF and NKF. The director of the NKF, Van Linge, was appointed as a member of the ACF board.[142]

These events initiated a new and more intense process of cooperation within the Dutch quinine industry. By mid-1917, the U-Boat warfare of the Germans and the British blockade had curtailed almost all trade between the Netherlands Indies and the Netherlands. Earlier, in 1916, both the NKF and ACF had signed large war contracts with the allied governments for the supply of

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[139] Cinchona Bureau to N.I. Kinavera, 27 oktober 1914. Item 9007, Archief NHM Nationaal Archief, Den Haag.
[140] Kruizinga 2011, 51-59.
[141] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940.*(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 31-32. In regard to the British blockade and the Dutch trade in general, see Kruizinga 2011.
[142] Homan van der Heide 1960.

quinine sulphate and by late 1917 they faced shortages of cinchona bark.[143] The BKF representative in the Cinchona Bureau provided a solution. In contrast to the European manufacturers, the BKF's production of quinine sulphate profited from the war and demand for its quinine sulphate was outreaching production capacity. So, the three manufacturers signed a cost and profit agreement in which the two Netherlands-based companies would financially support the BKF in expanding its production capacity and in return the BKF would produce the large war-contract supplies of quinine sulphate for the NKF and ACF. The BKF's profits would then be distributed equally amongst the three companies.[144] This agreement created such a solid base of trust between the companies and on January 1, 1920, the three strengthened their cooperation by establishing the so-called 'Combinatie', a joint venture based on the promise that they would "cooperate as much as possible and support each other, but would remain in practice independent."[145]

The isolation of the German industry in combination with the growing cooperation within the Dutch quinine industry thus enhanced the cooperation within the Cinchona Bureau between the cinchona producers and the Dutch quinine manufacturers. The transformation of the two networks into a transoceanic network across the Dutch empire was further stimulated by the large sales of quinine sulphate by the Dutch industry and high profits for the cinchona producers. In 1916, both groups agreed to make a war adaptation of the Cinchona Agreement. The manufacturers were not obliged to buy a fixed amount of cinchona, but rather they would only buy the amount corresponding to their quinine sulphate sales. In return, the manufacturers would then pay the producers 50% of the price they received for each kilogram of quinine sulphate they sold.[146] This ensured large profits for both the cinchona producers and the Dutch quinine manufacturers between 1915 and 1920.[147] By 1920, the three Dutch quinine

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[143] The British blockade resulted in similar circumstances for the other products imported from the Netherlands Indies. See Kruizinga 2011.

[144] Bandoengsche kininefabriek, N.V. 1917.

[145] Bandoengsche kininefabriek, N.V. 1919 and *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940.*(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 32.

[146] "Kinabast en Kinine," *Economische-Statistische Berichten* volume 2, nr. 64 (21 maart 1917), 212-213.

[147] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940.* (Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 31 and "Kinabast en Kinine," *Economische-Statistische*

manufacturers had "sold roughly 320.000 kilograms of quinine with a profit of *f* 17.900.000," with the BKF responsible for almost the entire world production of quinine sulphate.[148]

The Second Cinchona Agreement: the formalisation of the Dutch-controlled cartel

The annual report of the BKF in 1919 stated that in 1918, the three Dutch quinine companies "offered to enter a new agreement with the cinchona producers on Java, while they would promise the other participating manufacturers of the old contract to hand over their share of the barks."[149] In other words, the three Dutch quinine manufacturers would represent the other members of the quinine cartel in the negotiations with the cinchona planters and traders for a new Cinchona Agreement. On 18th September 1917, representatives of the three manufacturers met with representatives of the German quinine manufacturers in Arnhem, not far from the German border. During this meeting, the Germans agreed that the new Cinchona Agreement would only be signed between the Dutch manufacturers and the cinchona producers.[150] Isolated as a result of the war, the German manufacturers saw no other option than to place control over the essential raw material into the hands of the Dutch.

With the agreement between the Dutch and German manufacturers, the negotiations for a new Cinchona Agreement gained force. During the autumn and winter of 1917, several meetings were held between the Commission for the Preparation for a new cinchona contract (*Commissie tot Voorbereiding van het nieuwe*

Berichten vol. 2, no. 64 (21 maart 1917), 212-213. Not only the cinchona-quinine industry profited from the disruption of German exports, but also other sectors of the Dutch (chemical and pharmaceutical) industry. See, amongst others, Homburg 2000, Kruizinga 2011 and Sluyterman 2004.

[148] Bandoengsche kininefabriek, N.V. 1919*,* Bandoengsche kininefabriek, N.V. 1920 and Ziegler 2003, 136.

[149] Bandoengsche kininefabriek, N.V. 1919.

[150] Copy of the Auszug Protokoll über eine Besprechung in Chininangelegenheit unter den Mitgliedern der Holländischen und Deutschen Gruppe, in Notulen der gecombineerde Vergadering van de Commissie tot voorbereiding van het nieuwe Kina-contract en de Nederlandsche groep Kinine-fabrikanten, 4 Oktober 1917 Item 9007, Archief NHM, Nationaal Archief, Den Haag.

kina-contract) and the Dutch quinine manufacturers. The Commission represented the cinchona producers and was led by importer-producer J. Vorstelman. In the minutes of two meetings, two central issues were discussed that differed from the first agreement. The first issue concerned the "transfer of the control of both the cinchona bark as quinine (also in regard to the settlement of the prices) to the Cinchona Bureau." On this issue, the producers and manufacturers quickly agree. The second issue of how to divide the price of one kilogram of quinine sulphate between the producers and manufacturers was discussed more vigorously. The producers wanted a 60/40 split of the sales profit in their favour. The manufacturers (Van Linge and Camphuis), however, complained that this was not fair because it did not take into account the costs they had in selling the quinine product. They proposed a 55/45 split of the sales profit.[151] In the end, producers and manufacturers agreed that over the first 20 guilders of the sales price, the producers would receive 60% and from the remainder of the sales price, a 50% share.[152]

In 1918, Dutch producers and manufacturers signed the Second Cinchona Agreement. In comparison with the first agreement, two changes were crucial in formalising the Dutch control and dominance over the worldwide production and distribution of cinchona and quinine.[153] The first was that the agreement placed control over the production and trade of cinchona and quinine into the hands of the Cinchona Bureau. This meant that the Bureau would be responsible for setting production quotas for the cinchona producers and fixing selling prices for quinine sulphate. The second important change was that the agreement was signed between the cinchona producers and only the three Dutch quinine manufacturers. The new board of the Cinchona Bureau thus became a 100% Dutch-controlled agency that controlled almost 90% of the worldwide production and distribution

[151] Notulen der gecombineerde Vergadering van de Commissie tot voorbereiding van het nieuwe Kina-contract en de Nederlandsche groep Kinine-fabrikanten, 20 November 1917 Item 9007, Archief NHM, Nationaal Archief, Den Haag.

[152] Commissie tot Voorbereiding van het nieuwe kina-contract to members of Kinavera, 24 Januari 1918 Item 9007, Archief NHM, Nationaal Archief, Den Haag and 'Kina-Overeenkomst', Economische-Statistische Berichten 3:134 (24 juli 1918), 649-650.

[153] Notulen der gecombineerde Vergadering van de Commissie tot voorbereiding van het nieuwe Kina-contract en de Nederlandsche groep Kinine-fabrikanten, 20 November 1917 and Commissie tot Voorbereiding van het nieuwe kina-contract aan leden van Kinavera, 24 Januari 1918 Item 9007, Archief NHM, Nationaal Archief, Den Haag.

of cinchona and hence quinine sulphate.[154] So, with the signing of the second cinchona agreement, the shift of the internal cartel balance of power from the German pharmaceutical industry to the Dutch cinchona and quinine network with the Cinchona Bureau as its "executive power" was formalised (table 9).[155]

Table 9: The Cinchona Bureau in 1918.

Company	Location
Nederlandsche Kininefabriek	Maarssen, The Netherlands
Amsterdamsche Chininefabriek	Amsterdam, The Netherlands
Bandoengsche Kininefabriek	Bandung, Netherlands Indies
122 Cinchona enterprises (organized in the Kinavera & Netherlands Indies Kinavera)	Amsterdam & Batavia, the Netherlands and Netherlands Indies

Conclusion

So, by the turn of the twentieth century, the German pharmaceutical industry took the lead in the cinchona-quinine supply chain and in efforts to safeguard their position established the first international pharmaceutical cartel. Thus, the three major German companies were able to control the quinine sulphate and quinine medicine prices at the time. In addition, with their extensive industry experience and superior technical expertise the Germans were able to enforce high-quality standards throughout the supply chain. Paradoxically, this would reverse the balance of power in the supply chain. By adapting the same high-quality and standardized demands in the production of cinchona bark and quinine sulphate, the Dutch colonial agro-industrial system for cinchona and quinine was able to open up the German-controlled international cartel and gradually shift the internal balance of power in its favour. Three interrelated factors in this power shift can be distinguished.

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[154] The Cinchona Bureau was also represented by a special delegation in the Netherlands Indies. 'Kina-Overeenkomst', *Economische-Statistische Berichten* 3:134 (24 juli 1918), 649-650.

[155] In theory, the old international quinine cartel of 1894-1907 was never completely abolished during the war; however, in practice its activities were taken over by the Dutch quinine manufacturers. In 1922, the international quinine cartel was re-established under the leadership of the Dutch quinine industry and strongly imbedded in the structure of the Cinchona Bureau. Kerbosch 1931a, 339.

First, the production of cinchona bark in the Netherlands Indies was strongly interconnected with the production of the semi-finished quinine sulphate and quinine medicines by the pharmaceutical industry through the inclusion of the laboratory in the breeding, cultivation and quality control of cinchona bark. The integration of the laboratory for quality control in both the production and trade of cinchona bark resulted in a process of standardization that strengthened the Dutch colonial cinchona network and was supportive of the cross-formation of a Dutch quinine-sulphate industry. The Dutch GCE as the scientific and coordinating centre played a crucial role in creating a Netherlands Indies' cinchona production and trade dominance with its focus on quality standards and high yields that matched the demands of the German pharmaceutical industry.

The second interlinking factor was the establishment and maintenance of a transoceanic network of cinchona producers, quinine manufacturers, (colonial) scientists and state officials across the Dutch empire and their crucial control over cinchona bark stocks. Despite the dominance of a high-quality and standardized cinchona bark, the cinchona network across the Dutch empire lacked the ability to exploit its raw material to produce a finished product, since it depended on the high-tech German pharmaceutical industry as a market. It was the emergence of the two Dutch quinine manufacturers alongside the cinchona network, which created the conditions to challenge the German control over the international cinchona and quinine markets. Both manufacturers built a strong base in scientific and organizational approaches to the extraction and sale of quinine sulphate and gained access to the raw material through their direct contacts within the cinchona network. Furthermore, through the establishment of the American transpacific connection, the Dutch manufacturers had direct access to an exponential medical market for the distribution of their quinine sulphate product. These conditions enabled the NKF and BKF to compete with the German pharmaceutical industry for control of the cinchona and quinine markets. In this way, the emerging cinchona network and Dutch quinine industry challenged the German pharmaceutical industry and created the conditions to take complete control over the delicate balance in the product chain.

The third interlinking factor was the outbreak of the First World War and the isolation of the German pharmaceutical industry, which provided the last factor in the shift of internal control and power of the cartel. As a result of the extraordinary circumstances of the war, the three major German companies lost their position in the Cinchona Bureau and hence control over access to the raw

material and became dependent on the Dutch quinine industry for their raw material. At the same time, the Dutch industry took over the foreign export markets and positioned itself as the world's largest quinine sulphate producer. This catalysed the establishment and growth of a Dutch transoceanic network and created the circumstances for the formalisation of Dutch control over the international quinine cartel through the signing of the second Cinchona Agreement and the formation of a Dutch-controlled Cinchona Bureau by 1918.

Chapter 3. Quinine, Malaria and the Cinchona Bureau
Marketing practices and circulation of knowledge in the Dutch transoceanic cinchona-quinine enterprise (1920s-1930s)[1]

With the signing of the 1918 Cinchona Agreement, almost 70 years after the introduction of the first cinchona bark tree in the Netherlands Indies, the shift of power in the international quinine cartel from the German pharmaceutical industry to the Dutch cinchona and quinine producers. By the early 1920s, this network gradually developed into a Dutch transoceanic cinchona-quinine enterprise, centred around the Cinchona Bureau, which according to *Fortune* magazine in 1932 was, "perhaps the most scientific organization in existence for the controlled supply of a plant product and the controlled release of the material manufactured from it."[2] In this chapter, I will argue that during the interwar period, the Cinchona Bureau became the decision-making centre of this international cinchona-quinine pharmaceutical cartel and controlled the worldwide production and trade of an essential medicine. In addition, I will show how this Dutch controlled international consortium was able to capitalise on one of the first international public health campaigns to fight malaria, led by the League of Nations, in its promotion of the sale of quinine as an antimalarial medicine.[3]

The outbreak of the First World War and its circumstances provided a powerful factor in the development of Dutch industry.[4] New opportunities for expansion, the economic boom of the first post-war years and an energetic spirit among government and business, stimulated the Dutch industry to find new ways to cooperate, concentrate and diversify its activities.[5] Some of the largest Dutch enterprises, like Philips and Unilever, expanded rapidly during this period by

[1] A shortened version of this chapter was published in the *Journal of the History of Medicine and Allied Sciences*. Roersch van der Hoogte and Pieters 2015.

[2] "Cinchona-Quinine to You," *Fortune* (February 1932), 83.

[3] According to Nicolas King, the first international congresses and supra-national organizations were established to 'address international health' during the second half of the nineteenth and early twentieth century. King 2002, 764-765.

[4] Vermij 2010, 191 and Sluyterman 2005, 81-82.

[5] Schot and Rip 2010, 22, Vermij 2010, 191 and Sluyterman 2005, 84.

scaling up their production capacities and in-house research facilities.[6] In the chemical industry, the war resulted in the ambition to create a Dutch chemical-industrial complex based on the German model by integrating companies and university-based research institutions.[7] Although this project failed to become reality, it created new forms of cooperation, such as the establishment of the Association for the Dutch Chemical Industry and most importantly provided the industry with a new national self-awareness as being a 'mature' industry capable of competing with the larger industries around the world, and the German chemical industry in particular.[8]

At the same time, the government supported closer cooperation between academia and industry and various ideas for the creation of nationwide institutions and committees for scientific advice and industry stimulation.[9] In other words, the war stimulated and strengthened the idea that the creation and diffusion of scientific-technological knowledge was central for the growth and further development of the Dutch economy. So, during the interwar years, the scientist-industrial networks developed further. For example, cooperation between university professors and companies increased and a new generation of highly educated (chemical) technicians began to work for various companies and or university laboratories.[10] In this way, Dutch companies shifted from importing scientific-technological knowledge to developing and inventing new scientific-technologies on their own.[11]

The opportunities of the interwar years and the growing awareness of the relationship between economic performance and scientific-technological knowledge, however, were not only realized by the large-scale companies like Philips, Unilever (or Royal Dutch Shell, AKU, DSM), but also by a large number of small- to medium-sized companies. These companies became more vertically or horizontally integrated, initiated new forms of cooperation with the government and implemented scientific-technological developments in their production and

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[6] Sluyterman 2005, 72-75, 83-84.
[7] Homburg, Rip and Small 2000 and Homburg 2000.
[8] Homburg 2000, 329-330.
[9] Schot and Rip 2010, 22-23.
[10] Homburg 2003.
[11] Homburg 2003, Faber 2001 and Baggen, Faber and Homburg 2010.

sales capacities.[12] The introduction of research laboratories, the government-supported growth of technical education and subsequent emergence of a new generation of well-educated technicians, the circumstances of war and the economic boom of the first years of the 1920s all stimulated Dutch industry to cooperate, concentrate and diversify its activities.[13] In this chapter, I will show how the circulation of knowledge and the employment of the laboratory for cinchona and quinine production and distribution was strongly influenced by these same processes of cooperation, concentration and diversification. However, I will show that these processes took place within the realm of the Dutch colonial empire by connecting colonial agricultural production of cinchona bark with the Dutch industrial production of quinine.

This chapter is structured chronologically and thematically around three aspects of control and governance. I will begin with the logistics of organizing a transoceanic network and move to the business of blocking the circulation of useful knowledge for potential competitors. Next I will discuss the organization of an integrated public relations bureau that blended scientific marketing with the agenda-setting process of an emerging international health organization fighting malaria in the interwar period. In the first two sections, I will show how the Cinchona Bureau built on a high-quality and innovative raw material to become the decision-making centre of the Dutch-controlled international quinine cartel. They were thus able to influence a process of diminished incentive for scientific innovation and purposefully manipulate the circulation of knowledge and non-knowledge. In the third and fourth sections, I will show how the Dutch-led international cartel, through the consolidation of the Cinchona Bureau as the decision-making centre, was able to strengthen its control over the entire product chain from raw material to final product. For example, I will demonstrate how the enterprise was able to withstand external pressure from the Swiss pharmaceutical company F. Hoffmann-La Roche that attempted to undermine the Cinchona Bureau's control of the product chain. In the last section, I will show how the Cinchona Bureau succeeded in colonizing the international public health campaign against malaria for commercial purposes.

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[12] See Faber 2001 for 5 examples of such medium-sized companies.

[13] Sluyterman 2005, 84. See also Bouwens and Dankers 2012.

The establishment of the Cinchona Bureau as the decision-making centre of the Dutch-led international quinine cartel (early 1920s)

In 1923, the Dutch transoceanic cinchona-quinine consortium was formed by 122 cinchona estates in the Netherlands Indies (represented by 45 cinchona producers) and three Dutch quinine manufacturers (one in the Netherlands Indies and two in the Netherlands) (see figure 6). Within this consortium, the three Dutch quinine manufacturers formed a strong alliance, as a result of the gradual cooperation initiated during the war, thus resulting in the formation of the transoceanic joint venture, the Combinatie, in 1920. Over the next few years, several additional steps were undertaken to strengthen the Combinatie's position on the (inter)national quinine markets and within the Cinchona Bureau. First, the managements of the ACF and the Dutch subsidiary of the BKF were merged. This meant that the director of the BKF, pharmacist S. Camphuis van Velzen, also became the director of the ACF.[14] Second, in 1919, a wholesale department was established at the ACF for the sale of "tablets, ampules and quinine in confection form," which became central to the distribution of the Combinatie's products during the following years.[15] Third, initial steps for dividing up the activities were taken. The BKF became the central quinine producer and distributor for the Asian market, meanwhile the ACF became central for producing fine chemicals for the internal Dutch market and later for export to the United States (additional pharmacists were hired for this specific purpose), while the NKF focused on the production of bulk quinine sulphate.[16] As a result, the Combinatie took a strong position within the Cinchona Bureau. Furthermore, during the war and early post-war years, the Combinatie gained considerable experience and influence in the international quinine markets. So, when there was stagnating demand for quinine

[14] *Geschiedenis der N.V. Amsterdamsche Chininefabriek 1881-1940.*(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 32-33.

[15] Aan de Raad van Beheer en de Directie der N.V. Amsterdamsche Chininefabriek bij het vijfentwintig-jarig bestaan der Pharmaceutische Afdeeling. Unpublished report, January 1944). Brocacef Archief, Maarssen.

[16] Aan de Raad van Beheer en de Directie der N.V. Amsterdamsche Chininefabriek bij het vijfentwintig-jarig bestaan der Pharmaceutische Afdeeling. Unpublished report, January 1944). Brocacef Archief, Maarssen.

in the early 1920s, the Dutch cinchona-quinine consortium had to rely on the Combinatie's knowledge and experience to thrive.[17]

Between 1920 and 1923, the large profits from the war had ended and the Combinatie's directors such as van Linge lobbied for a modified Cinchona Agreement. They argued that the current agreement (a fixed amount of cinchona bark would be supplied by the cinchona producers) did not correspond well with the stagnating demand for quinine. So, they proposed a new more flexible agreement in which the annual quinine sales by the manufacturers (including non-Dutch manufacturers) would correspond with the producer's supply of cinchona bark. Aware that the cinchona producers would not be enthusiastic about this modification because it would make them more dependent on quinine sales, the Combinatie's directors stressed that they had built a network of sales agents across the world that would help to create "a healthy market and hence serve the interests of both the producers and manufacturers."[18] Furthermore, the Combinatie had strongly advocated for the Cinchona Bureau's decision-making role and position as the centre where this evaluation had to be made.[19] According to van Linge, "they [the producers] must therefore not speak of the sales policy of the manufacturers, yet of the sales policy of the Cinchona Bureau."[20]

The chairman of the Cinchona Bureau, lawyer Mr. J. Gerritzen supported in this endeavour the Combinatie. As the former director of the Javasche Bank in the Netherlands Indies and a member of the Dutch Parliament (by 1922 and until 1925), Gerritzen acted as a political broker and expert in colonial business. He

[17] M. Kerbosch, Het Kina-Monopolie van Nederlandsch-Indië (Nota voor het Ministerie van Overzeese gebiedsdelen, 1945), no. 106, Kerbosch-collection, KITLV, Leiden. According to Goss, production stabilized in the early 1920s with bark prices higher than they had been before the war. However, this does not correspond with the minutes of the Cinchona Bureau and the decision to match cinchona production with the sales of quinine. Furthermore, Groothoff (former adjunct-director of the Government Cinchona Estate) stated in 1925, "during the last years the consumption of quinine has declined as the result of the reduced purchasing power of Russia and other countries." Groothoff 1925, 114 and Goss 2014, 15.

[18] Combinatie aan Kinabureau, 21 November 1923, Item 9010, Archief NHM, Nationaal Archief, Den Haag.

[19] *Mededeelingen van het Kina-Bureau* No. 5 Oktober 1921, II. Colonial Collection (KIT), Leiden University Library.

[20] Notulen vergadering Vereeniging van vertegenwoordigers, 29 maart 1922, Item 9010, Archief NHM, Nationaal Archief, Den Haag.

convinced the cinchona producers of the advantages of the Combinatie's proposal by pointing out the declining prices for Netherlands Indies' export commodities on the international markets.[21] In the end, despite serious disagreement amongst cinchona producers, both Gerritzen and the Combinatie's arguments managed to convince the cinchona producers to accept the agreement modification in "the interests of the cinchona producers."[22] In 1945, the director of the GCE, Mathieu Kerbosch, clearly stated that the producers' "main objective with the agreement [with the Combinatie] was to make a profitable cinchona cultivation possible and safeguard it for the future."[23]

In the meantime, the Cinchona Bureau's governance and control was further strengthened by the implementation of the Uniform Analysis Method and founding of the Cinchona Laboratory in 1920. Since 1820, when quinine was isolated, chemical analysis of the quinine content of cinchona bark became an essential part of production and trade in cinchona and quinine. For cinchona producers, chemical analysis was necessary to determine the value of their product, while quinine manufacturers needed chemical analysis to estimate the amount of quinine that could be extracted from the bark. However, until 1920, essential chemical analyses were dispersed across multiple laboratories and lacked standardization. To standardize the method, and thus control this essential tool within the entire product chain, the Cinchona Bureau established a specific "Commission for a Uniform Analysis Method." The commission was formed by six Dutch professors of chemistry and pharmacy and their goal was to "investigate the existing method of analysis entry to formulate a uniform method of analysis

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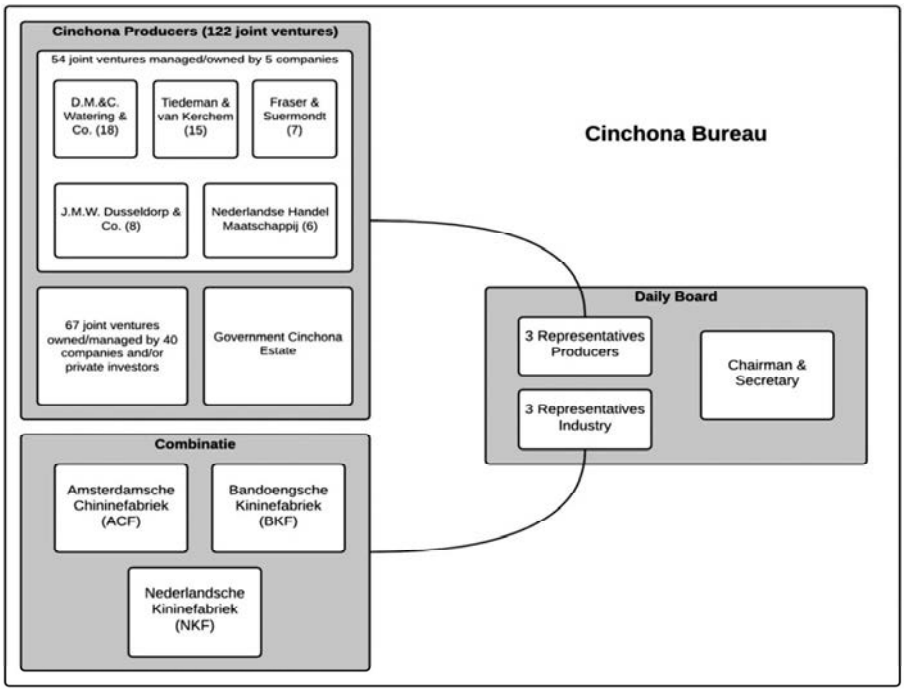
[21] *Kina-Mededeelingen* No. 4, I (November 1920) and No. 5, II (Oktober 1921), Colonial colletion (KIT), Leiden University Library and M. Kerbosch, 'Nota betreffende de kina-situatie, behoorende bij het schrijven van den dircteur der Gouvernements Kina-onderneming dd. 13 januari 1927 No. 25 aan den directeur van Landbouw, Nijverheid en Handel te Buitenzorg. No. 98 Kerbosch collection, KITLV, Leiden. Regarding the term political broker and the position of J. Gerritzen as such within the colonial business elite, see Taselaar 1998, 219-222.

[22] Verkorte notulen van de vergadering van de Vereeniging van Vertegenwoordigers der bij de Kina-overeenkomst aangesloten Producenten, 7 oktober 1921 and Notulen van de vergadering van de Vereeniging van Vertegenwoordigers der bij de Kina-overeenkomst aangesloten Producenten, 29 maart 1922, Item 9010, Archief NHM, Nationaal Archief, Den Haag.

[23] M. Kerbosch, Het Kina-Monopolie van Nederlandsch-Indië (Nota voor het Ministerie van Overzeese gebiedsdelen, 1945), no. 106, Kerbosch-collection, KITLV, Leiden.

with the goal to establish a bureau of analysis."[24] The result was the creation of a Uniform Analysis Method and founding of the Cinchona Laboratory. From then on, the Cinchona Bureau was the worldwide centre for chemical analysis, hence strengthening its position of control over the prices for both cinchona bark and quinine medicines.

Figure 6: The Cinchona Bureau, the decision-making centre of the Dutch cinchona-quinine enterprise (1923)

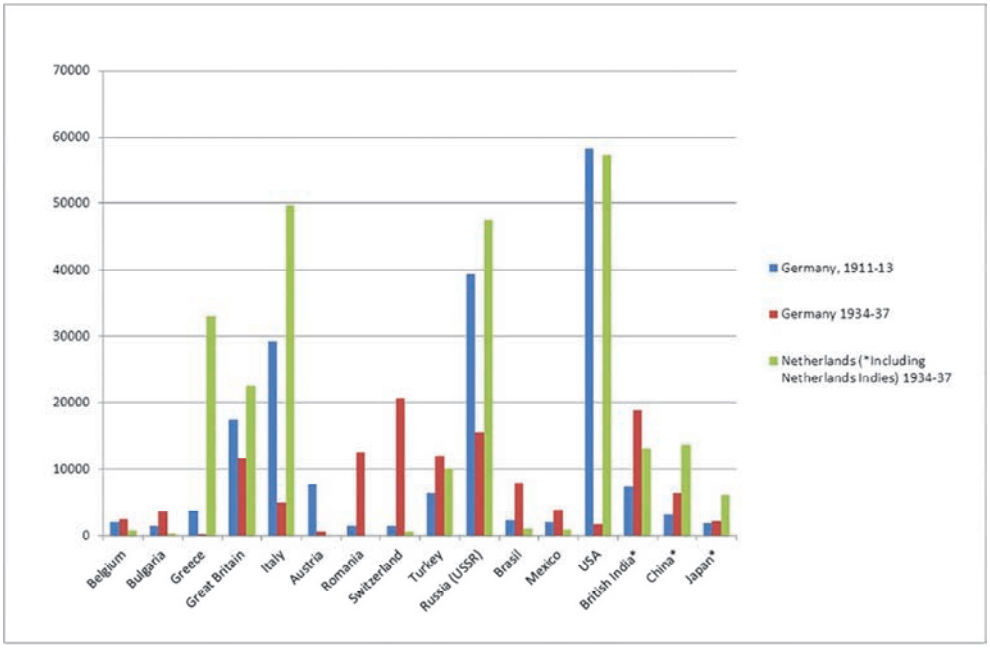


With the establishment of the Cinchona Laboratory and Uniform Analysis Method in 1920 and the signing of the 1923 Cinchona Agreement, the Cinchona Bureau became the decision-making centre of a Dutch transoceanic cinchona-

[24] *Kina-overeenkomst 1918*, PD.3.1.CHI – 100556, Historisches Archiv Roche, Basel and Kinabureau to Kerbosch, 21 januari 1924, Item 8977 Archief NHM, Nationaal Archief, Den Haag. The six were Prof. Dr. S. Hoogewerff, Prof. Dr. A.V. Holleman, Prof. Dr. J. Boeseken, Prof. Dr. G. van Iterson Jr., Prof. Dr. P. van Romburgh and Prof. Dr. P. van der Wielen. *Mededeelingen van het Kina-Bureau*, No. 1 Januari 1920, I, Colonial Collection (KIT), Leiden University Library.

quinine enterprise, responsible for determining the quotas and prices for both cinchona bark and quinine. Furthermore, as illustrated by figure 7, the Dutch cinchona-quinine enterprise became the largest quinine distributor in the world. In 1929, Arent Roelf van Linge thus declared: "In 1923 we were the ruling party."[25]

Figure 7: The distribution of quinine by Germany and the Netherlands in kilograms in 1911-13 and 1934-37.[26]



The Cinchona Bureau and Cinchona Field Station: less incentive for innovative cinchona bark production and a blocking of knowledge circulation

An important element in the process of the Cinchona Bureau becoming the decision-making centre was the tension between the local and global governance of this transoceanic pharmaceutical endeavour. Located on the premises of the Government Cinchona Estate (GCE) in the Malabar Mountains,

[25] Concept notulen vergadering 16 oktober 1929. Item 8979, Archief NHM, Nationaal Archief, Den Haag.
[26] Dethloff 1944, 240-248.

south of Bandung, in the Netherlands Indies, the Cinchona Field Station (CFS) had functioned as an autonomous centre for cinchona cultivation and significantly contributed to the dominant position of Dutch cinchona cultivation and the emergence of the transoceanic consortium that controlled the entire product chain during the early twentieth century. In this section I will show how during the 1920s and 1930s, the CFS' position was challenged by the decision-making centre of the Cinchona Bureau, diminishing the incentive for innovation and thus affecting knowledge circulation about cinchona cultivation.

The first signal of this change was the implementation of the aforementioned Uniform Analysis Method and founding of the Cinchona Laboratory in Amsterdam. By 1923, the Cinchona Bureau decided that all cinchona bark shipped to Amsterdam would be analysed by the Cinchona Laboratory, while the CFS would only analyse the cinchona bark produced by the GCE and bark supplied directly to the BKF in Bandung.[27] Because the majority of the cinchona bark was shipped to Amsterdam, this meant that the Cinchona Laboratory became responsible for the majority of the chemical analyses. However, the director of the CFS, Mathieu Kerbosch, protested against this in a letter to Gerritzen and called the decision a "horrible mistake" and "quite unfair with respect to the oldest of the two laboratories." In response, Gerritzen wrote Kerbosch that he himself (Kerbosch) had approved this new regulation when he had agreed to the renewed cinchona agreement and emphasised that in addition to the chemical analysis, the field station did and still does "useful work" for the general interest of the entire cinchona cultivation.[28] Kerbosch responded by emphasising that the field station "has a direct contact with the [cinchona] cultivation, which cannot be replaced by your laboratory" and that the majority of the producers consider "the deliberate discrimination of the Governments Cinchona Field Station as an unfair and unmotivated measure."[29] In the end, Kerbosch yielded to the centralization of the

[27] *Mededeelingen van het Kina-Bureau*, No. 3 July 1920, I, Colonial Collection (KIT), Leiden University Library.
[28] Kinabureau aan Kerbosch, 21 januari 1924, Item 8977, Acrhief NHM, Nationaal Archief, Den Haag.
[29] Kerbosch aan Kinabureau, 5 augustus 1924, Item 8977, Acrhief NHM, Nationaal Archief, Den Haag.

chemical analysis in Amsterdam and the result was a substantial loss of revenue for the CFS (since producers paid small fees for every analysis).[30]

In 1926, the situation worsened for the CFS when the Cinchona Bureau declared that from then on all chemical analyses conducted by the Cinchona Laboratory in Amsterdam would be free of charge for the cinchona producers. In a letter to its representatives in the Netherlands Indies, the Cinchona Bureau's chairman, Mr J. Gerritzen, was well aware of the consequences this decision for the CFS: "We must not overlook that the consequence of this would be that the source of revenue for the cinchona field station in the Indies, would decrease substantially."[31] So, to compensate for this loss and to "preserve the very useful and necessary scientific practice of the CFS," Gerritzen continued, the Cinchona Bureau is "willing to annually subsidize" the field station. However, there was an important 'but' to this subsidy. The Cinchona Bureau would only subsidize the field station when the other small group of cinchona producers (who were not members of the Cinchona Bureau), were willingly to contribute more to the CFS.[32] In other words, by centralizing chemical analyses at the Cinchona Laboratory in Amsterdam, the Cinchona Bureau curtailed the CFS' most important source of revenue. At the same time, the Cinchona Bureau placed the responsibility of the viability of the field station in the hands of the non-Cinchona Bureau members.

One year later, in 1927, the CFS' autonomy was further restrained. After more than five decades of aiding scientific practices in the cinchona cultivation, the colonial government decided to stop financing the field station and turn it over to the private sector (although, Kerbosch remained as director and the CFS remained on the premises of the GCE).[33] The cinchona producers vigorously discussed what to do with the field station. In the Netherlands, the cinchona producers (e.g. the Cinchona Bureau) argued that "considering the current circumstances there is not enough capacity to exploit an autonomous field station," while the producers in

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[30] Kerbosch aan Kinabureau, 6 december 1923 and Kerbosch aan Kinabureau, 5 augustus 1924, Item 8977, Archief NHM, Nationaal Archief, Den Haag.

[31] Agenda vergadering Kinabureau 1 oktober 1926, Item 8977, Archief NHM, Nationaal Archief, Den Haag.

[32] Agenda vergadering Kinabureau 1 oktober 1926, Item 8977, Archief NHM, Nationaal Archief, Den Haag.

[33] Jaarboek van het Departement van Landbouw, Nijverheid en Handel in Nederlandsch-Indië 1926, 106-108, Colonial Collection (KIT), Leiden University Library.

the Netherlands Indies recognized the necessity of a field station, but were not enthusiastic about contributing more than they already did.[34] In the end, the cinchona producers in the colony decided to continue with the CFS, however shrinking its activities and the number of scientists.[35] In 1933, the CFS merged with the tea and rubber field stations and became one central field station, the West-Java Field Station.[36] Over the next few years, staff and research activities were reduced and by 1937, only five of the original nine full-time scientists remained in the service of cinchona cultivation.[37]

In addition to declining financial resources, two other factors influenced the further reduction of the CFS. First, cinchona overproduction was a significant problem by 1932. In a memo to the colonial administration, in 1932, Kerbosch advised, "the cultivation techniques do not have to make such advances, that the production capacity per hectare will rise."[38] In other words, overproduction as a result of a steady increase in the number of hectares cultivated with cinchona and the CSF's scientific work improving the cinchona bark had both interfered with profitable cinchona cultivation. The second factor was the largest cinchona producers' ability to conduct an important part of the scientific practices normally done by the CFS. After decades of experience and knowledge exchange with the CFS, these producers had established their own high-quality experimental fields, seed selection programs and cloning experiments.[39] In this way, the incentive to continue supporting a fully autonomous scientific field station had decreased considerably during the late 1920s and 1930s.

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[34] Jaarverslag Departement Landbouw, Nijverheid en Handel Nedederlandsch-.Indië 1926, 106-108 and Vergadering Bestuur Bond van Eigenaren Nederlandsch-Indische Kina-Ondernemingen, 27 maart 1928, Item 9010, Archief NHM, Nationaal Archief, Den Haag.

[35] Voorzitter Vertegenwoordiging der Bergcultures aan Algemeen Landbouw Syndicaat, 1 mei 1928, Item 9010, Archief NHM, Nationaal Archief, Den Haag. See also, Schoor 2012, 43-45.

[36] Schoor 2012, 45.

[37] Verslag over het jaar 1937 van Het Algemeen Landbouw Syndicaat, Colonial Collection (KIT), Leiden University Library. See also Maat 2001, 79.

[38] M. Kerbosch, Nota betreffende den toestand en de vooruitzichten der kinacultuur in Nederlandsch-Indië (1932), no. 48, Kerbosch-collection, KITLV, Leiden.

[39] Ebes and Verhaar 1950.

However, these events did not mean that scientific research on cinchona stopped completely. By the mid-1930s, the Cinchona Bureau decided that open publication of scientific work conducted in the Netherlands Indies regarding cinchona had to stop in order to prevent useful knowledge falling into the hands of potential competitors, which would have undermined the Netherlands Indies' domination of the global markets. In 1946, according to the botanist P.M. Prillwitz, "in line with the monopolistic structure of the cinchona cultivation publication was prevented or kept within a limited circle."[40] An important reason to curtail the dissemination of information regarding cinchona was the growing threat of cinchona cultivation programs in other parts of the world, foremost in the Belgian colony of the Congo.[41] In other words, the once autonomous local scientific centre of the Netherlands Indies' cinchona cultivation was subordinated to the global commercial interests of the cinchona-quinine enterprise. At the same time, global control by the Dutch transoceanic cinchona-quinine enterprise was consolidated by strengthening the Cinchona Bureau as the decision-making centre.

The Cinchona Bureau consolidating control over the entire product chain:the F. Hoffmann-La Roche case (1920s)

In 1924, a German trader in colonial commodities, Emil Helfferich, confessed in a conversation with the Swiss pharmaceutical firm F. Hoffmann-La Roche: "I have come to realize that the German manufacturers are completely dependent on the Dutch."[42] Helfferich referred to the Dutch incorporation of the renewed international quinine cartel under the Cinchona Bureau. In 1922, the international quinine cartel was formally re-established, although it had never ceased to exist. However, this time, the cartel leadership was placed in the firm hands of the Dutch with the founding of the Bureau Central des Fabricants de Quinine in Amsterdam.[43] The three German quinine manufacturers – C.F.

[40] Nota No. 18, in W.C. Heusden, *Kina*, Colonial Collection (KIT) Leiden University Library. The last issue of *Cinchona*, the CFS journal, was published in 1933, but reappeared briefly in 1951. Colonial Collection (KIT), Leiden University Library.

[41] Kina-Legger (24-04-1938-31-01-1940), Item 8991, Archief NHM, Nationaal Archief, Den Haag.

[42] Bericht über die Besprechung mit Herrn Emil Helfferich im Basel am 13 Januar 1925, PD.3.1.CHI – 102361, Historisches Archiv Roche, Basel.

[43] The offices of the Bureau Central were located in the same building as those of the ACF and BKF (the Combinatie headquarter) at De Wittenkade 48, Amsterdam. *Geschiedenis der*

Boehringer & Söhne, Chininfabrik Braunschweig Buchler & Co. and the Verenigte Chininfabriken Zimmer & Co. – had high hopes that through the international cartel they could restore their pre-war status and regain a position inside the Cinchona Bureau. In 1924, for example, the three German companies demanded more "equalization in raw material supply, [quinine sulphate] production and clearance [of payments]" between the Dutch and Germans within the workings of the international cartel.[44] However, for the Dutch this was not an option and anxious for a renewed strong German presence on the international markets both the cinchona producers and Combinatie agreed to keep these German manufactures out of the Cinchona Bureau.[45] The Dutch thus neglected the German petitions and in response the Germans did not dare to criticize the Dutch attitude because of the "danger that much larger damages would be inflicted" and because of the "importance of the export."[46] By the mid-1920s, Dutch control was no longer challenged by the German companies or the other companies in the international quinine cartel, but rather by one Swiss outsider, the pharmaceutical firm F. Hoffmann-La Roche.

The Dutch control of the international markets by the early 1920s was challenged by the appearance of so-called "outsider" manufacturers. These manufacturers tried to take advantage of the market's stability by undermining the fixed quinine prices set by the international quinine cartel. One of these outsiders was the Japanese pharmaceutical company, Hoshi's Pharmaceuticals. In 1917, when two cinchona producers in the Netherlands Indies who did not belong to the Cinchona Bureau signed contracts with Hoshi, the Japanese were able to purchase cinchona bark and develop into one of "the strongest competitors ever faced by

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N.V. Amsterdamsche Chininefabriek 1881-1940.(Amsterdam: Unpublished report). Brocacef Archief, Maarssen, 33.

[44] Letter from Hans Engelhorn to Dr. P.H. van der Meulen, 16 december 1924, PD.3.1.CHI – 102364, Historisches Archiv Roche, Basel.

[45] Concept verkorte notulen vergadering van het Kinabureau, 5 juni 1924, Item 8977, Archief NHM, Nationaal Archief, Den Haag.

[46] Dethloff 1944, 196.

the cartel."[47] In one of the Cinchona Bureau's meetings, fear about Hoshi and their possible cooperation with German companies resulted in one cinchona producer representative declaring: "the only solution to overcome any negative consequences for the Cinchona Agreement is that the manufacturers agree with Hoshi."[48]

It was the appearance of the Swiss pharmaceutical firm F. Hoffmann-La Roche on the quinine stage during the early 1920s, however, that most strongly challenged Dutch control of the international markets. In approximately 1921, F. Hoffmann-La Roche entered the quinine business, however, aware of Dutch dominance in the market, they were not willing to subject themselves so easily to Dutch control (as the German companies had done).[49] Instead, as explicitly stated by director Emil Barrell, F. Hoffmann-La Roche wanted to break the Cinchona Bureau open and have "real equality with all manufacturers having a seat and vote in the Cinchona Bureau."[50] To do this, Barell stated, "the supply of cinchona bark has to be secured."[51] So, in 1923, F. Hoffmann-La Roche signed contracts with three cinchona producers in the Netherlands Indies (who were not part of the Cinchona Bureau) for the supply of cinchona bark.[52] This caused major concerns within the Cinchona Bureau and by 1924-1925 various meetings were held to discuss how to manage this "outsider." By late 1925, however, F. Hoffmann-La Roche and the Combinatie (representing the Cinchona Bureau) agreed that the Swiss company could join the international cartel in return for several exclusive privileges, such as a substantial production quota and continuation of their

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[47] Citation in "Japanese producer joins Kina-Bureau," *Oil, Paint and Drug Reporter* Nov 22, 1926, Vol. 110, p. 21 + 38D. Hoshi also tried to establish, unsuccessfully, cinchona plantations in the hills of Taiwan and build cinchona plantations in Peru. Yang 2012.

[48] Concept Verkorte Notulen vergadering 4 juni 1924, Item 8977, Archief NHM, Nationaal Archief, Den Haag.

[49] According to Hans Conrad Peyer, F. Hoffmann-La Roche founder Frits Hoffmann and the company's senior management did not have high hopes for cartels and hence preferred to do business without them. Peyer 1996, 96-99.

[50] Emil Barell to Hans Engelhorn, 31 May 1926, PD.3.1.CHI – 102364, Historisches Archiv Roche, Basel.

[51] Emil Barell to Hans Engelhorn, 9 September 1924, PD.3.1.CHI – 102364, Historisches Archiv Roche, Basel.

[52] Fuchs 2002.

contracts with the three cinchona producers in the Netherlands Indies until 1928.[53] In the same round of negotiations, Hoshi was also convinced to join the international quinine cartel in 1926, thus making Hoshi's agent in London respond, "at the present time there is nowhere in the world a manufacturer of quinine absolutely independent of the Cinchona Bureau and the Quinine Convention. Every maker of importance is either an active member of the convention or is under the influence sufficiently to remove all element of price competition."[54]

Despite Dutch courting, F. Hoffmann-La Roche maintained their goal to open up the Cinchona Bureau. In correspondence with the other non-Dutch members of the international cartel, F. Hoffmann-La Roche management repeatedly stated that their goal was still to force the Dutch to open up the Cinchona Bureau to the other cartel members and share their control of cinchona bark stocks. In this endeavour, they received enthusiastic reactions from the other non-Dutch members, who were extremely annoyed by the attitude and ruthless behaviour of the Combinatie within the Cinchona Bureau who were exclusively focused on gaining increasing control over the quinine markets. As Barell explained the Dutch way of doing business in 1927:

> If a manufacturer learns that a government, e.g. in Bulgaria, intends to buy 100 kilos of a certain quinine salt, he writes or cables immediately to Amsterdam, mentioning the fact and asking the permission to offer an inside price. If the Quina-bureau agrees with the proposal, the other manufacturers cannot quote at the same price, but have to keep in the background. Unluckily very often the Dutch refuse and simply state that the Quina-bureau has decided to give the Dutch group the right to sell in that case. A systematic campaign has been launched to increase more and more the power of the Dutch who insensibly may try to impose on the quinine market their own trade mark.[55]

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[53] Various documents in Item 8977, Archief NHM, Nationaal Archief, Den Haag.

[54] "Japanese producer joins Kina-Bureau," *Oil, Paint and Drug Reporter* Nov 22, 1926, Vol. 110, p. 21 + 38D.

[55] Emil Barell to Roche New York, 22 January 1927, PD.3.1.CHI – 102364, Historisches Archiv Roche, Basel.

The dynamics of the non-Dutch manufacturers' submission to the will of the dominant Dutch Combinatie made the British manufacturer and cartel member Howards & Co. write in 1927, "You know that we very heartily agree with you as to the desirability of converting our Convention from an Autocracy into a Republic."[56] In another example, Frederick Rosengarten, director of Powers-Weightman-Rosengarten in Philadelphia responded to the question of whether he approved the Dutch method of control, "I certainly do not! They have hogged it from the beginning and they have treated German, French, and American manufacturers most shamefully!"[57] At the same time, however, the non-Dutch members, and especially the Germans, did not dare to openly criticize the Dutch because of the "danger that much larger damages would be inflicted" and because of the "importance of the export."[58] F. Hoffmann-La Roche's campaign was thus strongly welcomed by the non-Dutch members of the international cartel in their fight to dethrone the Dutch. However, to open up the Cinchona Bureau, F. Hoffmann-La Roche needed to find support amongst a number of the cinchona producers. Informed by its agents in the Netherlands and Netherlands Indies, F. Hoffmann-La Roche relied on the growing unrest and criticism that was boiling amongst a number of the cinchona producers in the Netherlands Indies to achieve its goal.

As mentioned earlier, since the early 1920s, demand for quinine had stagnated and in response the Cinchona Bureau (as the decision-making authority) had decided to restrict the production and export of cinchona bark.[59] This had caused major unrest particularly for smaller cinchona producers, who were left with unsold bark on their estates and a loss of profit. They felt they were not well represented in the Cinchona Bureau and accused the Cinchona Bureau of being "tied to a leash" to the Combinatie, which was not acting as a neutral organisation

[56] Howards & Son to F. Hoffmann-La Roche, 2 February 1927, PD.3.1.CHI – 102364, Historisches Archiv Roche, Basel.
[57] E.H. Bobst to Emil Barell, 25 January 1927, PD.3.1.CHI – 102364, Historisches Archiv Roche, Basel.
[58] Dethloff 1944, 196.
[59] M. Kerbosch, Het Kina-Monopolie van Nederlandsch-Indië (Nota voor het Ministerie van Overzeese gebiedsdelen, 1945), no. 106, Kerbosch-collection, KITLV, Leiden.

serving the interests of both groups.[60] In 1923, according to the former secretary of the Netherlands Indies' Kinavera, H.S. Abrahamson:

> "The greatest menace to the Dutch monopoly comes from within, yet even this is hardly a nature to cause violent perturbation. This danger may be sought in the difficulty experienced in reconciling the interests of all the planters, particularly the vociferous group that clamors for a planters' factory or the right to ship "crudum" (a semi-manufactured product) instead of the bark."[61]

This 'vociferous' group (organised in the so-called 'Syndicate Planters Quinine Factory' (*Syndicaat Planters Kininefabriek*) and led by the tea and cinchona planter K.A.R. Bosscha), lobbied for the establishment of a separate planters' quinine factory in the Netherlands Indies as the best solution to provide the cinchona producers with the profit they deserved.[62] In addition, an anonymous letter sent to Gerritzen from the Netherlands Indies describing a "Roche conspiracy" in which Roche and two other manufacturers would leave the international cartel and cooperate with several cinchona producers to form a "cinchona trust" was taken seriously.[63] Although no names were mentioned, the Cinchona Bureau's members were well aware that this 'conspiracy' was inspired by Cornelis Marinus Pleyte D'Ailly, a Netherlands-based cinchona producer.

As a member of a distinguished family of pharmacists, Pleyte D'Ailly was the director of the company Koninklijke Pharmaceutische Handelsvereeniging (KPH) and hence a shareholder of one of the oldest cinchona plantations in the

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[60] Notulen van de commissie van advies i.z. wijziging van de kina-overeenkomst, 7 januari 1927, no. 15, Kerbosch-collection, KITLV, Leiden. See also Doorman 1927.

[61] Abrahamson 1923, 485.

[62] Verslag der Nederlandsch-Indische vereeniging tot bevordering van de belangen der kinacultuur 1920, Item L 2301, Colonial collection (KIT), Leiden University Library, H.J. Lovink aan GG, 19 oktober 1912, verbaal 17 maart 1918, no. 18, Item 1024, Archief Ministerie van Koloniën 1900-1950, Nationaal Archief, Den Haag and K.A.R. Bosscha aan Amorie van der Hoeven, 9 juni 1922, Boxmapinv.nr. PD.3.1.CHI – 102361, Historisches Archiv Roche, Basel.

[63] Anonymous to Gerritzen, 3 januari 1927, Item 15, Kerbosch-collection, KITLV, Leiden.

Netherlands Indies, Argasarie.[64] The other major Argasarie shareholder was the German quinine manufacturer Zimmer & Co. whose director Dr. A. Weller had played an important role in establishing the Cinchona Agreement during the early 1910s.[65] In 1913, Argasarie joined the Cinchona Agreement. However, when Agreement was renewed in 1923, the Argasarie shareholders decided to step out of the Agreement thus making Argasarie one of the largest and oldest estates not to join the Agreement.[66] Argasari was one of the three estates that signed an agreement with Roche in 1923. In 1926, Pleyte D'Ailly published the pamphlet *Kina-Producenten versterkt Uwen Band!* arguing for the abolishment of the Cinchona Agreement in its present form and the establishment of a new form of Agreement excluding the quinine manufacturers.[67] Although Pleyte D'Ailly struck a sensitive nerve regarding the control of the manufacturers over the producers, in the end, his collaboration with Zimmer & Co. (and later Roche) did not help his credibility amongst most cinchona producers. In sum, these examples show that by the mid-1920s, several producers began to threaten to leave the Cinchona Bureau, and argued that they would be able to sell their entire output for better prices on the free market.[68]

It was this criticism and uncertainty amongst a number of the producers that gave F. Hoffmann-La Roche the idea that opening up the Cinchona Bureau was feasible. However, F. Hoffmann-La Roche's agents had misjudged the strong cooperation between the cinchona producers and the Dutch quinine manufacturers within the Cinchona Bureau and had overlooked the central role of the director of the GCE, the pharmacist Mathieu Kerbosch (1880-1972). As I have shown in the first two chapters, since the 1890s, the GCE had positioned itself as the largest individual cinchona producer, but more importantly as the

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[64] In 1927, the KPH merged with the N.V. Koninklijke Pharmaceutische Fabriek v/h Brocades & Stheeman, forming the largest pharmaceutical company in the Netherlands before the Second World War. Huisman 1999, 458 and Jong 1999, 51.

[65] *Handboek voor cultuur- en handelsondernemingen in Nederlands-Indië* (1888).

[66] *Handboek voor cultuur- en handelsondernemingen in Nederlands-Indië* (1923) and several documents of correspondence between Roche and Pleyte D'Ailly in PD.3.1.CHI – 102364 Roche Historischen Archive.

[67] C.M. Pleyte D'Ailly, *Kina-Producenten versterkt Uwen Band!* (Amsterdam, juni 1926). Colonial collection (KIT), Leiden University Library.

[68] Notulen van de commissie van advies i.z. wijziging van de kina-overeenkomst, 7 januari 1927, no. 15, Kerbosch-collection, KITLV, Leiden.

organizational centre of the Netherlands Indies' cinchona cultivation. In line with his predecessors, Kerbosch's main objective as director was to guarantee the future and prosperity of cinchona cultivation, which by the mid-1920s he believed was best guaranteed through cooperation with the Combinatie via the Cinchona Bureau.[69]

By the mid-1920s it became painfully obvious to the members of the Cinchona Bureau that something had to be done and Kerbosch was asked to step in. In 1925, he was made chairman of a Netherlands Indies cinchona producer's commission, which had the task of drafting a proposal for the new 1928 Cinchona Agreement to convince the smaller producers to stay within the Cinchona Bureau.[70] After two years of meetings, visiting planters and discussing the demands of the planters in the Netherlands Indies, Kerbosch drafted a final proposal with one main stipulation—all cinchona producers had to be equally represented in the Cinchona Bureau.[71] As a result, the *Vereniging voor Kinabast Producenten* (Cinchona Producers Association) was formed in 1927, and became the sole representative of all the cinchona producers in the Cinchona Bureau. In this way, the smaller cinchona producers had a visible representative in the Cinchona Bureau, which also strengthened cooperation within the Cinchona Bureau and simultaneously took the wind out of the sails of F. Hoffmann-La Roche's initiative.

At the same time, the three manufacturers enhanced their cooperation within the 'Combinatie' and founded a joint venture, the N.V. Combinatie van Amsterdamsche, Bandoengsche en Nederlandsche Kininefabrieken.[72] In 1930, this new joint venture became the official representative of all manufacturers in the Cinchona Bureau.[73] Although in practice the board of the Cinchona Bureau was led by the same men as before, the establishment of these two umbrella organizations created the basis for a more coherent and homogenized Cinchona Bureau. In 1929, the life-long director of the NKF and one of the driving forces

[69] See for example M. Kerbosch 1931a, 181-209.

[70] See the various letters between Kerbosch and the planters during the years 1926 and 1927, no. 15, Kerbosch-collection, KITLV, Leiden.

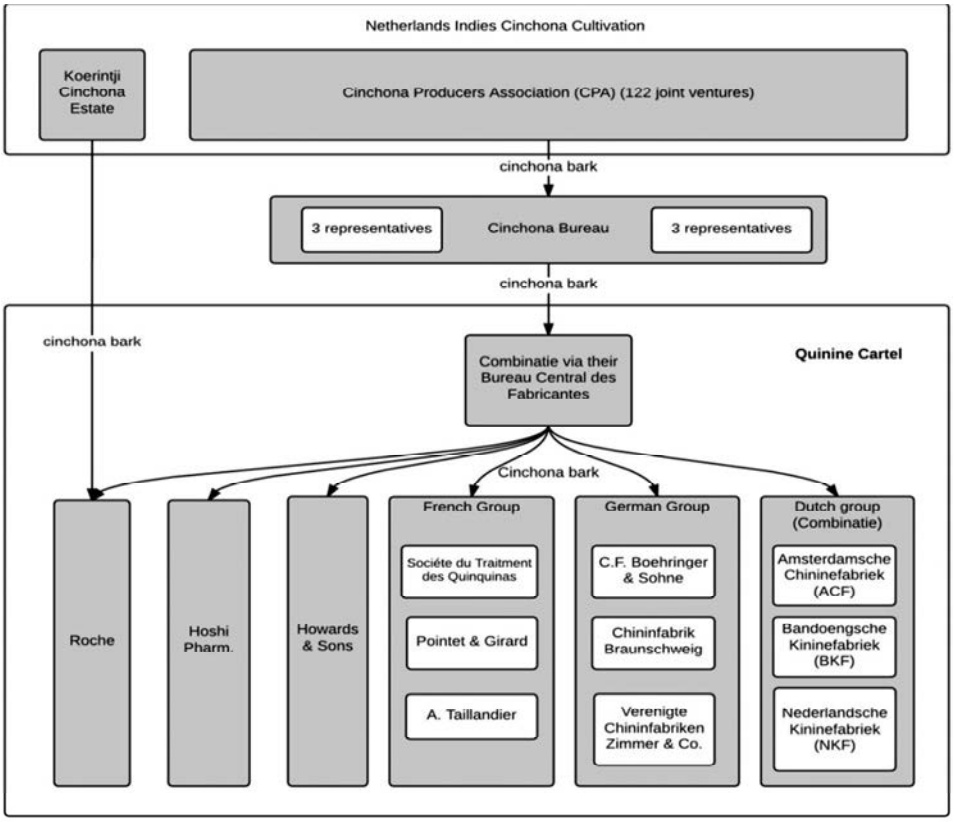
[71] Notulen van de commissie van advies i.z. wijziging van de kina-overeenkomst, 7 januari 1927, no. 15, Kerbosch-collection, KITLV, Leiden.

[72] Bandoengsche Kininefabriek, N.V. 1928.

[73] Concept notulen vergadering Kinabureau, 31 januari 1930, Item 8980, Archief NHM, Nationaal Archief, Den Haag.

behind the Cinchona Bureau, Van Linge, proclaimed in a general meeting of the Cinchona Bureau: "We must ensure that our organization will remain intact, we [therefore] need to standardize our cooperation. Manufacturers will not speak anymore as manufacturers, producers as producers, but we have to make so far as that we as manufacturer or producer have the same interests."[74]

Figure 8: The Cinchona Bureau as the decision-making centre by 1928-29.



In the end, F. Hoffmann-La Roche' activities made the international quinine cartel a more enlightened autocracy in the sense that the Combinatie became aware of the animosity it had created and took action to ensure that the other cartel members would experience a more equally managed cartel. Despite the

[74] Notulen algemene vergadering Kinabureau, 6 december 1929, Item 8979, Archief NHM, Nationaal Archief, Den Haag.

criticism, the German manufacturers flourished during the second half of the 1920s and Boerhinger Mannheim for example was able to concentrate a production capacity of 100.000 kilograms of quinine at their main site in Mannheim.[75] At the same time, the Cinchona Bureau remained closed to non-Dutch members and the F. Hoffmann-La Roche campaign had only further consolidated the position of the Cinchona Bureau as the decision-making centre for worldwide production and trade in cinchona bark and quinine. With the establishment of the Cinchona Producers Association (CPA), the Netherlands Indies' control over the worldwide cinchona bark supplies was further centralized at the Cinchona Bureau. Together with the Combinatie, which still controlled the international quinine cartel, the Dutch transoceanic cinchona-quinine enterprise was able to further strengthen its dominant position in the worldwide markets (see figure 8). The new 1928 Agreement, once again signed only between the cinchona producers (through the CPA) and the Combinatie, represented the consolidation of the Dutch control over international cinchona and quinine markets.[76]

Government restrictions and the consolidation of the Cinchona Bureau as the decision-making centre (1930s)

F. Hoffmann-La Roche's failed attempt to open up the Cinchona Bureau resulted in the strengthening and consolidation of the Dutch transoceanic cinchona-quinine enterprise and the decision-making role of the Cinchona Bureau, during the 1920s and early 1930s. However, the Cinchona Bureau's authority as the centre of the cinchona-quinine consortium was still contested by a number of the cinchona producers. As we have shown, the 1928 Cinchona Agreement and continuing control of the cinchona-quinine consortium were strongly influenced by the activities of the director of the GCE, Mathieu Kerbosch. In this section, I will show how by the mid-1930s, the Cinchona Bureau became the uncontested decision-making centre of cinchona cultivation and hence the transoceanic cinchona-quinine enterprise as a result of the implementation of Dutch government restrictions.

By the late 1920s and early 1930s, the Dutch cinchona-quinine consortium firmly controlled the worldwide quinine markets. The CPA controlled more than

[75] Fischer 1991, 126.

[76] Departement van Economische Zaken 1936.

90 per cent of the raw material and as such provided the Combinatie with the power to control the worldwide production and distribution of quinine medicines through the international quinine cartel. In practice, this meant that every quinine manufacturer and buyer in the world had to pass by the Cinchona Bureau before being allowed to produce or buy one kilogram of quinine.[77] As a result, prices for quinine were relatively high, which resulted in growing international criticism of the Cinchona Bureau's policy (see next section). There were also increasing amounts of cinchona bark offered on the international markets by a small group of "outsider" producers. At the same time, the high productivity of cinchona cultivation and the Cinchona Bureau's policy of matching the sales of quinine with cinchona bark supply had resulted in only 50 per cent of the cinchona bark produced by the cinchona producers being taken by the quinine manufacturers. In other words, half of the bark production was left on the estates and for the smaller producers in particular this resulted in a loss of income.[78] To stimulate demand, the Cinchona Bureau decided to lower the prices of quinine. However, this did not stimulate the Cinchona Bureau members' cinchona production and only encouraged several outsider producers to raise their production distribution output.

Thus, the main question for the Cinchona Bureau was how to address the problem of overproduction and how to maintain control over the production and trade of cinchona bark in and from the Netherlands Indies.[79] The answer was found in government restrictions. Since the outbreak of the worldwide economic depression in 1929, several agricultural export sectors, like sugar, rubber and tea in the Netherlands Indies were confronted with declining demand and hence profits. In order to support these important economic sectors, the colonial government initiated several restrictions to control production and exports.[80] Although cinchona cultivation was not hit hard by the crisis, the Cinchona Bureau regarded government restrictions as a good solution to ensure control over the growing

[77] M. Kerbosch, Het Kina-Monopolie van Nederlandsch-Indië (Nota voor het Ministerie van Overzeese gebiedsdelen, 1945), no. 106, Kerbosch-collection, KITLV, Leiden.
[78] M. Kerbosch, Nota betreffende den toestand en de vooruitzichten der kinacultuur in Nederlandsch-Indië (1932), no. 48, Kerbosch-collection, KITLV, Leiden.
[79] These issues were central during the many meetings of the Cinchona Bureau during 1930 and 1931. See Items 8980 and 8981, Archief NHM, Nationaal Archief, Den Haag.
[80] See amongst others Taselaar 1998.

sector of outsider cinchona producers.[81] In this opinion, the Cinchona Bureau was strongly influenced by Mathieu Kerbosch who was convinced that the colonial government had a moral obligation to support the cinchona cultivation, as it had done during the late nineteenth and early twentieth centuries. [82]

Over the course of 1933, Kerbosch cooperated intensively with the chairman of the Cinchona Bureau, P. Leendertz (1889-1951), in drafting a proposal for the colonial government to restrict the production and export of cinchona from the Netherlands Indies.[83] A central argument in the proposal was that if the government did not intervene, the presence of the outsider producers would worsen the problem of overproduction and the result would be "a strong price fall, the closure of cinchona businesses, the decline of the economic significance of the Netherlands Indies cinchona industry and finally the fatal disruption of the entire cinchona business."[84] In continuation, the proposal argued that this would have disastrous ethical and humane consequences and therefore, government intervention was critical to "guarantee the worldwide supply of cinchona [e.g. quinine]."[85] The proposal submitted to the Netherlands Indies' colonial government thus combined the commercial interests of the Cinchona Bureau in strengthening their control over the cinchona cultivation and the public health interests of the importance of the Netherlands Indies' cinchona cultivation for medical and humanitarian purposes, especially as set forth by Kerbosch.[86]

In January 1934, the Netherlands Indies People's Council (*Volksraad*) approved the restrictions thereby making the Netherlands Indies government responsible for controlling all cinchona production and exports. This situation

[81] Memorandum vergadering Kinabureau 18 juli 1933, Item 8984, Archief NHM, Nationaal Archief, Den Haag.
[82] Kopie van het rekest aan de Gouverneur-Generaal, 16 mei 1933, Item 8983, Archief NHM, Nationaal Archief, Den Haag.
[83] Leendertz was besides chairman of the Cinchona Bureau, also chairman of the Thee Producers Association and the International Rubber association. Taselaar 1998 , 101.
[84] Kopie van het rekest aan de Gouverneur-Generaal, 16 mei 1933, Item 8983, Archief NHM, Nationaal Archief, Den Haag.
[85] Nota 'De noodzakelijkheid van een algemeene, verplichte beperking in Nederlandsch-Indië van den Kina-aanplant en van den uitvoer van kinabast,' Item 8983, Archief NHM, Nationaal Archief, Den Haag.
[86] Goss has emphasised this latter point when referring to the government cinchona restrictions. Goss 2014, 16-17.

continued until the Japanese invaded the Netherlands Indies in 1942.[87] The new restrictions, which were to be controlled by the colonial Department of Economic Affairs, divided cinchona cultivation into three groups. The first and largest group consisted of the cinchona producers who were part of the Cinchona Bureau. The second group included the so-called 'free' cinchona producers (or outsiders according to the Cinchona Bureau) and the third and smallest group consisted of several native cinchona producers.[88] As a result of the restrictions, both the second and third groups of producers had little choice other than to sell their cinchona bark to the Cinchona Bureau (through the CPA), since they were the only buyer with permission from the colonial government to export cinchona bark. As a report of the Department of Economic Affairs clearly stated, "the current cinchona legislation leaves the Cinchona Agreement [e.g. Cinchona Bureau] untouched and secures her from the growing meaning of the outsider-producers."[89] An exception was made for F. Hoffmann-La Roche, who had an exclusive contract (as agreed upon 1928 when they signed the new Cinchona Agreement) with the largest 'free' or outsider producer, the Koerintji estate on the island of Sumatra (see figure 8).

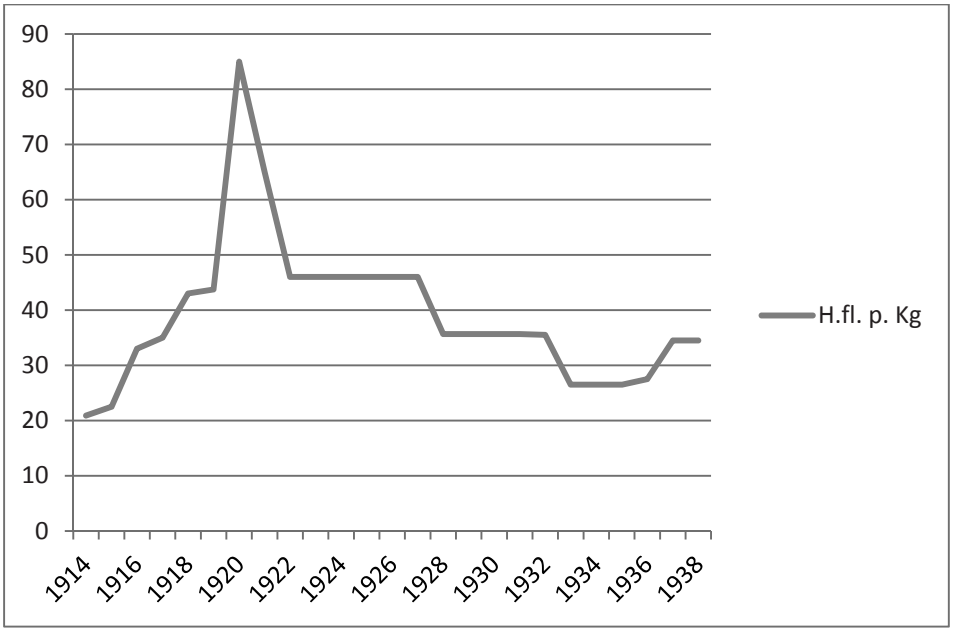
As a result of the restrictions, the colonial government had assumed control over the production and distribution of the cinchona cultivation and as already illustrated, the colonial government regarded the Cinchona Bureau as its most important partner (or buyer). In this way, control over the cinchona cultivation and hence the raw material was firmly centralized at the Cinchona Bureau making it the undisputed centre of the Dutch transoceanic cinchona-quinine enterprise. Ten years later in 1945, Kerbosch described the position of the Cinchona Bureau as follows:

> Because of the near monopolistic position of the Netherlands Indies cinchona cultivation, because of the Cinchona Agreement and the Cinchona-Restriction legislation, the Cinchona Bureau as a matter of fact controls the almost complete world production of

[87] Volksraad Zittingsjaar 1933-1934, no. 44, Kerbosch-collection, KITLV, Leiden and Departement van Economische Zaken 1936. The Dutch (colonial) government was one of the European governments that explicitly supported the establishment or continuation of cartels by the 1930s. Schröter 1996, 129-153 and Bouwens and Dankers 2010, 754-756.
[88] Departement van Economische Zaken 1936.
[89] Departement van Economische Zaken 1936. See also Taylor 1945, 76.

cinchona bark. It is the Cinchona Bureau that decides over all major transactions and which holds in total control the price-fixing.[90]

Figure 9: The price for 1 kilogram of quinine sulphate in Dutch guilders.[91]



The Cinchona Bureau and the marketing and colonization of malaria and quinine

Yet another dimension of the Dutch transoceanic cinchona-quinine enterprise's control during the 1920s and 1930s was the commercial colonization of the first international public health campaign to eradicate malaria. In this last section, I will focus on the organization of an integrated public relations bureau that blended scientific marketing with the careful integration of the results of the agenda-setting process of the League of Nations' Malaria Commission.

[90] M. Kerbosch, Het Kina-Monopolie van Nederlandsch-Indië (Nota voor het Ministerie van Overzeese gebiedsdelen, 1945), no. 106, Kerbosch-collection, KITLV, Leiden.
[91] Dethloff 1944.

Since the isolation of quinine in 1820, the medical profession has adopted the alkaloid quinine as the most essential and effective antimalarial medicine. However, limited supplies and high prices prevented the broad application of the medicine during most of the nineteenth century.[92] Nevertheless, by 1914, malaria was "almost considered as an anachronism" in large parts of Europe as a result of improved housing conditions, hygiene, agricultural techniques and scientific knowledge regarding the vector of malaria, the *Anopheles* mosquito.[93] Unfortunately, the First World War disrupted this development and millions of Europeans were infected with malaria. By 1923, one leading health officer of the League of Nations called malaria "undoubtedly the most important epidemiological problem of Europe."[94] In response, the League of Nations' Malaria Commission was founded in 1923-1924, and institutionalized the creation of an active international network of scientists dedicated to malaria from nearly all European nations. In the next two decades, the Malaria Commission, in collaboration with the Rockefeller Foundation, developed an international public health campaign led by a "new science of public health" to fight malaria across Europe.[95] From the start, the Malaria Commission considered malaria as a social disease in which the social-economic condition of the malarial patient was central. In this way, the administration of affordable and large quantities of quinine (clinical and prophylactic) was stimulated throughout the interwar period as an important part of the campaign.[96]

In 1923, the Cinchona Bureau founded the Bureau for the Increasing Use of Quinine (*Bureau ter Bevordering van het Kininegebruik*). As mentioned before, by the early 1920s, demand for quinine had stagnated and the Cinchona Bureau decided to restrict the production of cinchona bark in the Netherlands Indies. The cinchona producers reluctantly accepted this decision because the Combinatie had promised to set up and pay for a marketing department ("*propaganda bureau*") within the Cinchona Bureau to stimulate the sales of quinine sulphate and quinine and

[92] Webb 2009, 106-110.

[93] Borowy 2009, 112-113. In regard to scientific research on the mosquito as the vector for malaria, see amongst others Garrison 1978 and Webb 2009.

[94] Cited in Borowy 2009, 113. See also Gachelin and Opinel 2011, 432.

[95] For an overview and discussion of these approaches, see Borowy 2009, 239-255 and Gachelin and Opinel 2011. On the new science of public health see Löwy and Zylberman 2000, 371.

[96] Borowy 2009, 239-255, Gachelin and Opinel 2011 and Verhave 2011, 98.

hence the demand for cinchona bark.[97] So, over the course of 1923, a marketing department was established under the active directorship of S. Camphuis van Velzen, director of the BKF and ACF and board member of the Cinchona Bureau. In the following year, the first steps in setting up a marketing department were initiated by collecting significant knowledge from scientific articles, journals and publications, not only regarding malaria and quinine, but also in the broader fields of "hygiene, public health and the combat of contagious and endemic diseases."[98] The first product of the department was the publication of *Chininum*, in 1923, a bundle of scientific articles on the positive therapeutic results of quinine, and which was intended for distribution amongst professors of medicine and physicians worldwide.[99]

In the following years, the activities of the Bureau for Increasing Use of Quinine increased and in addition to the more scientific *Chininum*, the Bureau also began distributing more popular pamphlets like *Malaria and Quinine* and *Malaria and the large Cultures* ('Malaria en de groote Cultures') amongst planters, entrepreneurs and local governments in colonies like the Netherlands Indies, British India and French Indochina. In these pamphlets, the Bureau closely integrated the daily experiences of planters and/or their indigenous employees (*koelies*) regarding malaria with expert scientific statements on quinine (see illustration 6).[100] For this purpose, the Cinchona Bureau's marketing department collaborated closely with the international quinine cartel members. For example, the French and British quinine manufacturers translated the brochures to French and English respectively and the head of Boehringer Mannheim's medical research department, Fritz

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[97] *Kina-Mededeelingen* No. 4, I (November 1920) and No. 5, II (Oktober 1921), Colonial Collection (KIT), Leiden University Library and M. Kerbosch, 'Nota betreffende de kina-situatie, behoorende bij het schrijven van den directeur der Gouvernements Kina-onderneming dd. 13 januari 1927 No. 25 aan den directeur van Landbouw, Nijverheid en Handel te Buitenzorg. No. 98 Kerbosch collection, KITLV, Leiden.

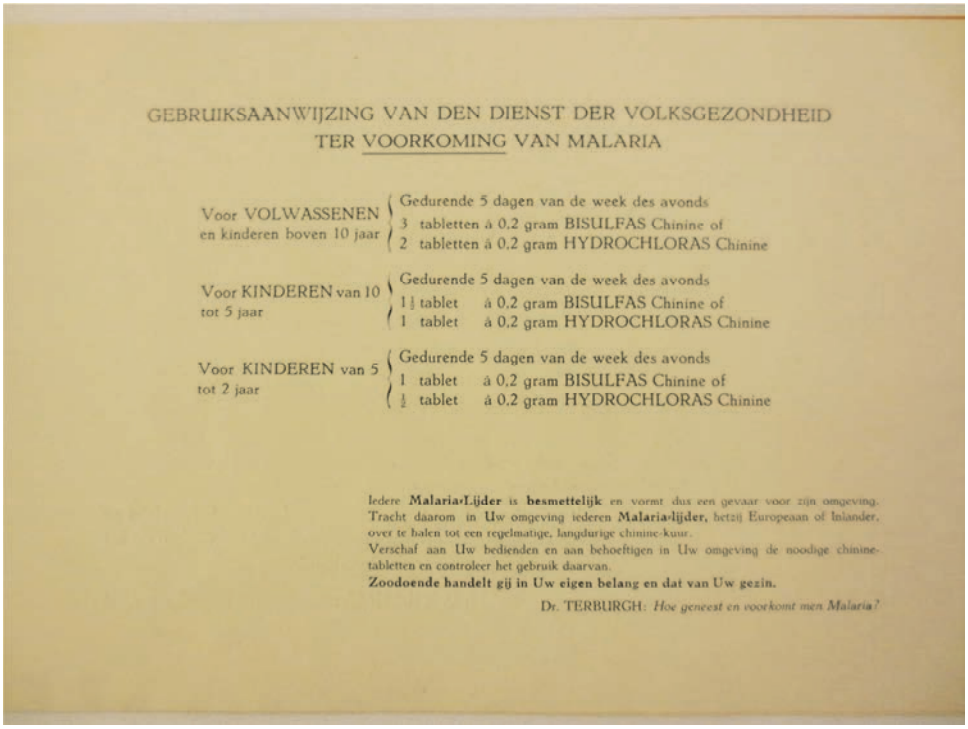
[98] Jaarverslag Bureau ter Bevordering van het Kininegebruik 1924, Item 8977, Archief NHM, Nationaal Archief, Den Haag. Similar developments have been recorded for other pharmaceutical companies. See, amongst others, Thoms 2013 and Liebenau 1986.

[99] Jaarverslag Bureau ter Bevordering van het Kininegebruik 1924, Item 8977, Archief NHM, Nationaal Archief, Den Haag.

[100] This new approach was implemented throughout the entire European pharmaceutical industry and seems to be closely linked to the growing cooperation and mutual dependency between the pharmaceutical industry and the medical profession. Wimmer 1992, 73-86, Thoms 2013 and Roersch van der Hoogte and Pieters 2010.

Johannesson wrote scientific-marketing brochures and books regarding the therapeutic effects of quinine.[101] So, stimulated by the commercial objectives of both the cinchona producers and quinine manufacturers, marketing increasingly came to dominate the Cinchona Bureau's activities during the 1920s.

Illustration 7: A page from a pamphlet distributed by the Bandoengsche Kininefabriek amongst planters in the Netherlands Indies (ca. 1930).[102]



GEBRUIKSAANWIJZING VAN DEN DIENST DER VOLKSGEZONDHEID
TER VOORKOMING VAN MALARIA

Voor VOLWASSENEN en kinderen boven 10 jaar	Gedurende 5 dagen van de week des avonds 3 tabletten à 0,2 gram BISULFAS Chinine of 2 tabletten à 0,2 gram HYDROCHLORAS Chinine
Voor KINDEREN van 10 tot 5 jaar	Gedurende 5 dagen van de week des avonds 1½ tablet à 0,2 gram BISULFAS Chinine of 1 tablet à 0,2 gram HYDROCHLORAS Chinine
Voor KINDEREN van 5 tot 2 jaar	Gedurende 5 dagen van de week des avonds 1 tablet à 0,2 gram BISULFAS Chinine of ½ tablet à 0,2 gram HYDROCHLORAS Chinine

Iedere **Malaria-Lijder** is **besmettelijk** en vormt dus een gevaar voor zijn omgeving. Tracht daarom in Uw omgeving iederen **Malaria-lijder,** hetzij Europeaan of Inlander, over te halen tot een regelmatige, langdurige chinine-kuur.
Verschaf aan Uw bedienden en aan behoeftigen in Uw omgeving de noodige chinine-tabletten en controleer het gebruik daarvan.
Zoodoende handelt gij in Uw eigen belang en dat van Uw gezin.

Dr. TERBURGH: *Hoe geneest en voorkomt men Malaria?*

From the beginning, in addition to regular quinine marketing, the Bureau for Increasing Use of Quinine spearheaded the objective to make "contact with different institutions of importance in the field of public health" and position the Cinchona Bureau as "intermediary between the sufferers of malaria, who need quinine, and the authorities, who are engaged in combating malaria."[103] So, in the

[101] Jaarverslag Bureau ter Bevordering van het Kininegebruik 1926, 1927, 1928, 1929, Item 8977, Archief NHM, Nationaal Archief, Den Haag.
[102] Item 8980, Archief NHM, Nationaal Archief, Den Haag.
[103] Jaarverslag Bureau ter Bevordering van het Kininegebruik 1924, Item 8977, Archief NHM, Nationaal Archief, Den Haag.

year that the Malaria Commission was established (1924), Camphuis van Velzen travelled to Geneva to meet Dr. Norman White, chief epidemic commissioner of the health committee of the League of Nations to inform him about the "organisation between the producers and manufacturers" (e.g. Cinchona Bureau) and how they could contribute in the international struggle against malaria.[104] Furthermore, national governments and (inter)national health institutions like the Red Cross were informed of the possibility of contacting the Cinchona Bureau for supplies of quinine sulphate and/or quinine medicines.[105] Thus, from the start, the international public health campaign in the fight against malaria was aligned with the Cinchona Bureau's marketing activities to stimulate the sales of quinine. By the late 1920s, these activities gained more importance as a result of the growing international criticism of the Cinchona Bureau's price policy.

In 1927, the Malaria Commission published its second general report and one main conclusion was that the demand for cinchona alkaloids (e.g. quinine) far outstripped the supply. In addition, the Cinchona Bureau was criticized for keeping prices of quinine too high and the Malaria Commission began to encourage initiatives to cultivate cinchona bark outside the Netherlands Indies.[106] In addition, governments confronted with malaria epidemics and endemics within their borders, complained they lacked sufficient funds for large supplies of expensive quinine as a result of the high prices set by the so-called "Quinine Trust."[107] If that was not enough, the Cinchona Bureau was confronted with an anti-trust lawsuit in the United States. An investigation under the direction of the United States Attorney General was started in October 1927 against "alleged violations of the Federal Anti-Trust Laws" by the so-called Quinine Trust.[108] This was the name given to a broad consortium of Dutch manufacturers, their agent in the United

[104] Goss 2014, 16.

[105] Jaarverslag Bureau ter Bevordering van het Kininegebruik 1924, Item 8977, Archief NHM, Nationaal Archief, Den Haag.

[106] Webb 2009, 150-151 and Borowy 2009, 239-255. Drug pricing is still one of the most contested issues in the present-day debate regarding the pharmaceutical industry and public health. Dukes 2002.

[107] Webb 2009, 149-150.

[108] Department of Justice, United States Attorney's Office to R.W. De Greeff & Co., 26 October 1927, Baltimore Industries Archive, series 55, item bi55_021 and "Quinine Firms Get Sunpoenas from U.S. Government Starts Investigation Of Alleged Trustlike Operations," *Oil, Paint and Drug Reporter* Vol. 112 (Oct. 31, 1927), 21.

States R.W. Greeff & Co., the American quinine manufacturers and the Cinchona Bureau. By March 1928, the allegations were foremost directed against the Dutch-led international cartel in the United States in which American quinine manufacturers like Merck & Co. (who had bought the largest quinine manufacturer in the United States, Powers & Weightman a year earlier) and New York Quinine & Chemical Works "have been coerced by the Dutch into entering into this arrangement."[109] The initial response of the Cinchona Bureau was to object to these accusations by stating that the Bureau was a "board, whose goal is to execute the Cinchona Agreement accordingly."[110] However, by mid-1928, it became clear for both the producers and manufacturers at the Cinchona Bureau that some kind of arrangement had to be made with the United States government. In the summer of 1928, Camphuis and Van Linge travelled to New York and agreed with the assistant attorney general that the Dutch would consent to conduct business in the United States within the confines of the anti-trust laws.[111] In the end, the Dutch were found guilty of violating the anti-trust laws, however, because of the concessions by Camphuis and Van Linge, they were only fined.[112] The Cinchona Bureau (and hence the Dutch cinchona-quinine enterprise) thus faced an issue of trust. In a meeting of the Cinchona Bureau in 1930, Van Linge argued for a quinine price reduction to improve the reputations of the Cinchona Bureau and the Dutch, so that "everybody who is part of it would not be regarded as extortionists and usurers."[113]

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[109] "Quinine Seized by Government in Action Against Monopoly. Six Tons Taken From Warehouse of Greeff & Co. As Grand Jury Examines Members of Trade – Long List of Defendants," *Oil, Paint and Drug Reporter* Vol. 113 (March 26, 1928), 25-26. In regard to the merger of Merck & Co. and Powers & Weightman, see Mahoney 1959, 30-31 and "Merck and Power-Weightman-Rosengarten Firms Consolidated: Long-Established Houses Act United Under Name of the Former," *Oil, Paint and Drug Reporter* May 16, 1927, p. 21+38C.

[110] Proces-verbaal vergadering Kinabureau, 27 april 1928, Item 8978, Archief NHM, Nationaal Archief, Den Haag.

[111] Concept verkorte notulen Buitengewone vergadering Kinabureau, 2 augustus 1928, Item 8978, Archief NHM, Nationaal Archief, Den Haag.

[112] "Quinine Trust Decree is Accepted by Dutch. Members of Monopoly Agree Not to Restrain Trade Or Control Prices," *Oil, Paint and Drug Reporter* Vol. 114 (Seot. 10, 1928), 16 and 73.

[113] Concept notulen gecombineerde vergadering Kinabureau en Bestuur VKP, 9 mei 1930, Item 8980, Archief NHM, Nationaal Archief, Den Haag.

By the late 1920s, the Cinchona Bureau had already implemented the so-called two-price system, based on two separate prices for two distinct quinine markets. The first price would be the regular high price set for the normal quinine markets, while the second price, much lower, would be reserved for governments who were in need of bulk quantities of quinine in their fight against malaria.[114] In continuation, the Bureau for Increasing Use of Quinine began to inform government health officials and public welfare institutions like the Red Cross and the Red Crescent of this new price system and the possibility of buying cheap quinine.[115] In these letters, the marketing department closely interlinked the Cinchona Bureau's position with the health campaign objectives of the Malaria Commission: "here we have two organizations which are complementary to each other; the League of Nations is in want of quinine for treating malaria patients and the Cinchona Bureau can offers this quinine at a low price."[116] To enhance the restoration of trust, the Cinchona Bureau also supplied regular amounts of free quinine samples to the Malaria Commission for scientific experiments. For example, as Iris Borowy has mentioned, the Commission tested two preparations "placed at their disposal by two quinine factories in Amsterdam and Turing" in hospitals in Algeria, Spain, Italy, Romania and Yugoslavia.[117] In other words, the Cinchona Bureau was boosting its trusted image by reconciling the needs of the Malaria Commission (affordable quinine medicine) with its commercial role as quinine producer and supplier[118]

By the late 1920s, the international community of scientists involved in the fight against malaria (brought together in the Malaria Commission and Rockefeller Foundation) became divided along two lines of actions: eradication and control of

[114] Kerbosch 1939, 279. See also Goss 2014, 16.

[115] Jaarverslag Bureau ter Bevordering van het Kininegebruik 1932, Item 8981, Archief NHM, Nationaal Archief, Den Haag.

[116] Jaarverslag Bureau ter Bevordering van het Kininegebruik 1932, Item 8981, Archief NHM, Nationaal Archief, Den Haag.

[117] Borowy 2009, 244.

[118] This fits well with what Joseph Gabriel has described as "the efforts to reconcile the ethical norms of medical science with the need for commercial firms to successfully introduce new products to the market in order to remain competitive." Cited in an interview with Gabriel on the points blog of the ADHS regarding his new book *Medical Monopoly: Intellectual Property Rights and the Origins of the Modern Pharmaceutical Industry* (University of Chicago Press 2014). http://pointsadhsblog.wordpress.com/2014/11/04/the-points-interview-joseph-m-gabriel/#more-11796 Consulted 05-11-2014.

the Anopheles mosquito or quininisation—distribution of quinine as a prophylaxis and first measure to fight malaria in combination with general sanitary measures.[119] For example, a member of the Malaria Commission, the Dutch biologist and entomologist Nicolaas H. Swellengrebel who had co-written the second general report of the Commission, had become less convinced of the "miraculous results" of quinine after travelling through various parts of Europe and the United States during the second half of the 1920s. He believed that the fight against malaria needed to be a combination of both approaches, which contrasted with the opinion of the majority of the Malaria Commission members who favoured the use of quinine over the significantly more expensive measure of mosquito control.[120] By the 1930s, several experiments were coordinated across the world by the Commission (for example in Algeria, Italy, Malay and Russia) to compare the safety and efficacy of several synthetic drugs with quinine and find cheap alternatives for quinine.[121] These synthetic antimalarial medicines, branded plasmoquine and atebrine, were launched in 1926 by the German chemical giant I.G. Farben and since then have been marketed across the world as effective alternatives for quinine.[122] In continuation, physicians and public health officials throughout the world began to show more interest in these synthetic quinine medicines.[123]

By the 1930s, the Cinchona Bureau's marketing activities began to focus more on these developments and in the process they capitalised on the Malaria Commission's emphasis on malaria as a social disease and the use of affordable and cheap antimalarial medicines. By the late 1920s, the Cinchona Laboratory had already anticipated these developments by extending its activities to testing and experimenting on the therapeutic efficacy of quinine, other cinchona bark alkaloids

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[119] Borrowy 2009, 239-255, Gachelin and Opinel 2011 and Verhave 2011.

[120] There is no evidence that Swellengrebel had any connection with the Dutch cinchona-quinine enterprise. According to Verhave, in another study, none of the investigations conducted in the Netherlands regarding the use of quinine as a measure to fight malaria were financed by the quinine industry. Verhave 1995, 254-255 and Verhave 2011, 133. For the career and life of Swellengrebel, see Verhave 2011.

[121] Borowy 2009, 252-253.

[122] M. Kerbosch, Nota betreffende den toestand en de vooruitzichten der kinacultuur in Nederlandsch-Indië (1932), no. 48, Kerbosch-collection, KITLV, Leiden. See also Greenwood 1995 and Eckart and Vondra 2000.

[123] Webb 2009, 143-144.

and synthetic antimalarial medicines.[124] During the 1930s, the goal was formulated to "find [new] derivatives based on the cinchona bark, which can be applied in those cases in which quinine does not work, so that people do not seek solace in the quinine allied synthetic preparations" and to "investigate systematically the therapeutic value of these derivatives and quinine in other fields than malaria control."[125] In this process, the Cinchona Bureau became more closely involved with the Amsterdam professor of pharmacy Dr. P. van der Wielen, who had also been an advisor and commissioner of the supervisory board of the Cinchona Laboratory since the early 1920s.[126]

Parallel to investigations in the Cinchona Laboratory, the Bureau for Increasing Use of Quinine began to align the growing scientific knowledge circulated by the Malaria Commission regarding quinine and the synthetic medicines and their emphasis on cheap medicines within their marketing activities. This is well illustrated by two pamphlets, which were distributed by the Cinchona Bureau worldwide during the second half of the 1930s. The first was *The Therapeutics of Malaria*, issued by the Cinchona Bureau in 1933, which was strongly based on the third general report of the Malaria Commission (1933). This pamphlet addressed the "most important drugs available for malaria control," namely quinine and the two synthetic antimalarial medicines atebrine and plasmoquine. In the last pages, the pamphlet summarized several main conclusions and cited the Commission's report in capital letters:

> The Malaria Commission wishes it to be understood quite clearly that, in their opinion, the new synthetic remedies now available are still in the experimental stage, and they consider that the time has not yet come when any of these drugs can be recommended as substitutes for, or in preference to, quinine and other preparations of cinchona bark.[127]

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[124] Verslag Commissie Toezicht Kinalaboratorium, 1932, Item 8983, Archief NHM, Nationaal Archief, Den Haag.

[125] Jaarverslag Kina Laboratorium 1934, Item 8986, Archief NHM, Nationaal Archief, Den Haag.

[126] Regarding the cooperation between academia and industry during the interwar years in the Netherlands, see Homburg 2003 and Huijnen 2011.

[127] Bureau for the Increasing Use of Quinine 1933a.

In the second pamphlet, titled *Can Nature be equaled by Synthesis in Malaria?* (1936), the Bureau for Increasing Use of Quinine further capitalised on the Malaria Commission's idea of malaria as a social disease and the availability of cheap, but safe and effective, antimalarial medicines. In this pamphlet, the *Short Quinine Treatment* was stressed, which according to the pamphlet was successfully applied by the medical health services in the Netherlands Indies and Greece and "from an economic standpoint is of the outmost importance, as the number of relapses is decreasing considerably."[128] Thereafter, followed various expert statements in which several side-effects of the use of the synthetic medicines (like "saturation of the liver" or "psychoses; collapse") were emphasised. The pamphlet concluded with two expert statements regarding the safety and efficacy of quinine and its affordable price. The first stated, "The two great advantages of quinine are (a) the rapidity with which it reduces fever and alleviates symptoms and (b) its safety" and the second, "The practical utility of quinine is not lessened. It is still our cheapest and, it would seem, our safest antimalarial drug."[129] So, the message of the Cinchona Bureau through these two pamphlets was quite straightforward—the best way to fight malaria was by the administration of cheap and affordable quinine.

By 1935, the League of Nations Health Committee had further coordinated international studies on the synthetics atebrine and plasmoquine and by the mid-1930s urged that a conference in which the "present state of production in relation to present and future world requirements, the production costs and retail prices, and methods of distributing drugs" should be considered.[130] Although all member governments expressed interest, the conference was never organised and according to Borowy "it is unclear whether this failure resulted from lobbying activities of the quinine production industry, from the approach of the war, from simple bureaucratic inertia or a combination of all."[131] Although, we do not have sources that indicate direct lobbying practices by the Dutch cinchona-quinine consortium, the marketing strategies of capitalising (colonizing) on the international public health campaign by the Cinchona Bureau seemed to have paid off during the second half of the 1930s.

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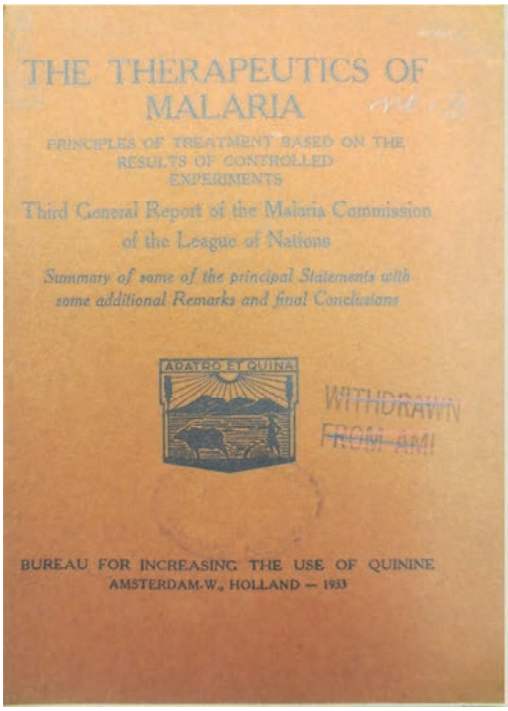
[128] Bureau for the Increasing Use of Quinine 1933b.
[129] Bureau for the Increasing Use of Quinine 1933b.
[130] Cited in Borowy 2009, 253.
[131] Cited in Borowy 2009, 253.

Illustration 8 & 9: Forefronts of pamphlets The Therapeutics of Malaria (1933) and Can Nature be equalled by Synthesis in Malaria? (1936)[132]



In 1936, the Bureau for Increasing the Use of Quinine was reorganised in the Cinchona Institute. The staff was extended, and included a fully paid and appointed medical advisor and in addition to the Dutch members of the Cinchona Bureau, the non-Dutch cartel members were more strongly involved in the activities of this new institute. Furthermore, new subsidiaries of the institute were founded in the Netherlands Indies (under supervision of the BKF), in New York City (the Cinchona Products Institute, Inc.) and in Brazil during the second half of the 1930s.[133] In 1937, the Cinchona Institute received almost three-quarters of a million guilders from the cinchona producers, the Combinatie and the non-Dutch

[132] Both pamphlets are located at the National Library of Medicine, Washington D.C., U.S.A.

[133] Concept verkorte notulen vergadering dagelijks bestuur Kina-Bureau, 30 juni 1939, Item 8992, Archief NHM, Nationaal Archief, Den Haag.

cartel members to spend on marketing and promotion activities.[134] The establishment of the Institute and its subsidiaries across the world indicate how the marketing activities of the Cinchona Bureau were strongly imbedded in the daily organization of the transoceanic cinchona-quinine enterprise. Furthermore, by capitalising on the international public health campaign to fight malaria, the Cinchona Bureau had managed to stimulate the administration of quinine and hence the commercial interests of both the cinchona producers and quinine manufacturers. As the Indian pharmacologist R.N. Chopra described in 1942:

> The Cinchona Bureau has tried and has been successful in effecting regulated and gradual reduction of the cinchona areas to proportions fitted to what the world can afford to buy and not what it really needs. In this way the price has been maintained at a level that leaves a profit both for the plantations and the factories.[135]

Conclusion

On June 11, 2009, the World Health Organization (WHO) signalled that a global pandemic of 2009 H1N1 "swine flu" influenza was underway and advised governments to stockpile Tamiflu and other anti-flu medicines in anticipation of the development of a vaccine. This action raised questions about the pharmaceuticalization of public health and an economically driven change in the concept of public health, from prevention and clinical care to merely drugs.[136] In this chapter, I have shown how 80 years earlier, a Dutch pharmaceutical consortium of cinchona producers and quinine manufacturers was able to capitalise on one of the first international public health campaigns to fight malaria led by WHO's forerunner, the League of Nations, thereby promoting the sale of quinine drugs in the fight against malaria at the expense of other community-based malaria control techniques and strategies.[137]

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[134] Propaganda 1937, Item 8988, Archief NHM, Nationaal Archief, Den Haag.

[135] Cited in "Malaria and antimalarials," *Current Science* Vol. XI, No. 9 (September 1942), 347-350; 349. In regard to Chopra and quinine in India, see Barton 2007.

[136] Zumach 2012. See also Abraham 2002.

[137] King 2002, 764-765.

The historical trajectory of the Dutch transoceanic cinchona-quinine enterprise and of the Cinchona Bureau as the decision-making centre of an international pharmaceutical cartel thus demonstrate how pharmaceuticals can be attached to and transform medical markets and practices through the corporate colonization of international public health efforts. Corporate colonization was not realised by bribing or lobbying in the strictest sense, but rather by a subtle colonization of the public health campaign message against malaria. This narrative reveals the extent to which the co-opting of scientists, government-officials, public health officers and drug company executives was mutually conceived (despite inequalities in power relationships) and mutually beneficial in terms of political and economic stakes. Scientists' central role in providing guidance, expertise and credibility proved critical for structuring the consortium's symbiotic relationship with the Dutch colonial government.

Scientific knowledge regarding malaria, quinine and public health in general was gathered and networks of experts were created to assess the opportunities and limitations of research and scientific literature. In this way, the Cinchona Bureau was positioned as the intermediary between the international expert community formulating the international public health efforts in the fight against malaria (e.g. the Malaria Commission) and the ultimate buyers and consumers of quinine. Furthermore, the Cinchona Bureau's marketing campaign capitalised on the Malaria Commission's message of malaria as a social disease by emphatically highlighting the scientific comparisons made between quinine and synthetic antimalarial medicines for safety, efficacy and affordability. The Cinchona Bureau thus colonized the international public health campaign by branding quinine as the best and cheapest way to fight malaria and promoted a particular aspect of the intersection of science, public health and public relations to advance a straight-forward economic interest.

This chapter also shows how the control of an essential medicine and the privileging of marketing over science resulted in a diminished incentive for scientific innovation and in curtailing the free circulation of knowledge. The commercial interests of both the cinchona producers and quinine manufacturers in stimulating quinine sales resulted in the Cinchona Bureau's decreased interest in continuing the scientific work at the Cinchona Field Station (CFS) in the Netherlands Indies as an essential driving force of the transoceanic cinchona-quinine enterprise. As a result, staff and research facilities were reduced and the CFS lost its autonomy as the scientific centre for cinchona cultivation. This was

further made clear when the free circulation of knowledge regarding scientific innovation of the cinchona cultivation was blocked to protect the Dutch-led cartel's commercial interests during the second half of the 1930s. So, with the development of the Cinchona Bureau as the decision-making centre of this international pharmaceutical cartel, commercial interests prevailed over scientific interests in cinchona cultivation. This resulted in a strategic engineering of the transoceanic circulation of knowledge and eventually in a knowledge blockade that would undermine innovation and ultimately threaten the Dutch-led cartel's market dominance in the post-war period.

Chapter 4. From Colonial Agro-Industrialism to Agro-Industrialism

Shifting networks of control and collapse of the Dutch transoceanic cinchona-quinine enterprise (1940s-1960s)[1]

In the previous three chapters, I have shown how by the turn of the twentieth century, the Netherlands Indies dominated the worldwide supply of cinchona bark and how during the next four decades, this high-quality and laboratory-conditioned cultivation of cinchona became the backbone of a Dutch transoceanic cinchona-quinine enterprise which controlled the international quinine markets. However, in the two decades after the Second World War, the Netherlands Indies' (Indonesian) cinchona bark global dominance ended and the Dutch transoceanic cinchona-quinine production and trade network collapsed. How can we explain this transformation? In this chapter, I will argue that this transformation was part of a process of globalization of the cinchona bark production sites. Colonial networks were replaced by new industrial networks and the colonial agro-industrial system was reconfigured into an agro-industrial system.

The reconfiguration from colonial agro-industrialism to agro-industrialism and the changing networks of control were closely linked to a process of globalization of agricultural production during the 1950s and 1960s. In cotton fields in the southern United States, for example, farmers, agricultural planners and scientists accepted that mechanization was inevitable and this provoked changes in the organization of production and distribution, as well as social organization and the nature of rural life. In this time period, the main cotton production sites shifted from fields east of the Mississippi to western states such as Texas, California and New Mexico.[2] Recently, scholars have tried to understand the globalization of agricultural production since the end of the Second World War, arguing that globalization's impact on rural localities is revealed not as domination or subordination, but rather as negotiation, manipulation, and hybridization.[3] In other words, globalization is a process of borderless network building and integration on

[1] A shortened version of this chapter has been accepted for publication by the journal *Itinerario*. Roersch van der Hoogte and Pieters 2016.
[2] Daniel 1986, chapter 11.
[3] Daniel 1986, 487.

an ever more global scale. Lawrence Busch and Arunas Juska have argued in their study about agricultural globalization that networks of production, distribution and consumption reached across localities, regions and nations and included new actors, products and technologies that were becoming less associated with a specific nation, but rather integrated into a global economic system managed by a relatively few increasingly powerful parties.[4] I will show how between roughly the 1940s and 1960s, a similar process of globalization for cinchona bark created new networks of production and distribution and hence new networks of control that were increasingly less associated with any one nation but with multinational companies. In this process, cinchona bark production sites were gradually integrated into the international (Dutch and German) quinine industry, henceforth restructuring the production processes of the entire product chain from raw material (cinchona bark) to final product (quinine). At the same time, in line with the argument of Geoffrey Jones that decolonization led companies to divest and invest elsewhere, this study also shows that the economic decolonization of Indonesia forced a process of de-globalization affecting the international business networks which had been formed around the cinchona-quinine network during the previous decades of the twentieth century.[5] As such, this study shows a mix of globalization and de-globalization happening in line with Indonesian decolonisation and at the same time agricultural globalization.

To understand this process, this chapter touches on two important historical changes in the 1940s and 1950s in the Netherlands, and Dutch industry in particular: a shift in industrial objectives and economies of scale and the decolonization of Indonesia (Netherlands Indies). After a period of protectionism between the two world wars, the globalization process after the Second World War dramatically shifted European companies' industrial objectives from securing adequate access to raw materials to producing and marketing (final) products.[6] For example, in the chemical and pharmaceutical industrial sectors, the development, production and marketing of new and better pharmaceuticals became a core business strategy. To accomplish this, a process of acquisitions, mergers and integration in these industries was set in motion, which created larger industrial

[4] Busch and Juska 1997, 689-694.

[5] Jones 2010.

[6] Homburg and Rip 2000, 405. See also Baggen, Faber and Homburg 2010, Faber 2001 and Sluyterman 2005, chapter 3.

companies.[7] In the Netherlands, this shift was influenced by the decolonization process of the Netherlands Indies or Indonesia.[8] In the decade after the independence of the Republic of Indonesia in 1949, there was an economic decolonization as Indonesian managers gradually replaced the Dutch managers of various enterprises (financial, plantation and trade). This culminated in the massive nationalization of Dutch enterprises from 1957-1958 and the exodus of thousands of Dutch managers and personnel.[9] The result was a shift in emphasis from production of and access to raw material (from the colony) to the production and marketing of the finished product.

This chapter is arranged as follows. In the first section, I will show how the Dutch cinchona-quinine enterprise became isolated and new networks of control emerged as a result of the Second World War. In the second section, I will show how the Dutch enterprise tried to regain control over the raw material and revitalize their pre-war colonial networks of control amidst the process of Indonesian decolonization and the presence of competitive cinchona cultivation in the Congo during the 1950s. In the last section, I will show how the networks of control had definitively shifted from a colonial agro-industrial network to a global agro-industrial network by the late 1950s and throughout the 1960s.

The Second World War, independence and Congo cinchona: the loss of control

With Germany's invasion of the Netherlands in May 1940, and the Japanese occupation of the Netherlands Indies in 1942, the activities of the Dutch transoceanic cinchona-quinine enterprise came to a halt. Only the Rio de Janeiro and New York offices remained active, however, with few resources and capable only "to observe and take notes."[10] The Cinchona Bureau continued to function,

[7] Homburg, Selm and Vincken, 2000, Reynders en Van Winden 1976 and Jong and Lange 1975. For the chemical-pharmaceutical industries in general, see (amongst others), Temin 1979, Greene 2007, Li 2014 and Chandler 2005.

[8] See Sluyterman 2005, chapter 3.

[9] Thee Kian Wie 2009, Lindblad 2008, chapter 7 and Lindblad and Post 2009. See also Doel 2000, and Bogaerts and Raben 2007.

[10] Rapport betreffende de werkzaamheden van het Rio-kantoor van den Gedelegeerde der N.V. Bandoengsche Kininefabriek – 1939-1942, Item 2997, Londens Archief, Nationaal Archief, Den Haag.

but rather quickly lost control as illustrated by the German quinine manufacturers' conduct. Before the Second World War, every new contract the German companies signed had to be reviewed and approved by the Cinchona Bureau. During the war, however, the German manufacturers ignored the Cinchona Bureau: "manufacturers have pinpointed the firm Buchler that this is not permitted, however still no answer is received."[11] Furthermore, the German occupation government obliged the Dutch quinine manufacturers to hand over their remaining cinchona bark and quinine stocks to German companies "without consulting the Cinchona Bureau."[12] The Cinchona Bureau was then sued by the German chemical giant I.G. Farben in an Italian court because of alleged "slander" by the Cinchona Bureau when they distributed two pamphlets about Farben's synthetic antimalarial medicines plasmoquine and atebrine. These pamphlets claimed that Farben's synthetic medicines were less effective than natural quinine in the treatment of malaria.[13] Thus, the Cinchona Bureau's control was undermined by German industry during the war.

In the early years after the war, the Dutch-led Cinchona Bureau vigorously tried to restore the pre-war balance of power. The first priority was to ensure control over cinchona bark in the Netherlands Indies and hence the control over the worldwide supply of this raw material. In contrast to other agricultural export crops, the Japanese had not neglected the cinchona plantations during their occupation.[14] According to the head of the cinchona department of the Central Association for Field Stations (*Centrale Proefstations Vereeniging*) P.M. Prillwitz in 1946, "the general condition of the cinchona enterprises can be regarded as satisfying."[15] However, the Japanese had shipped tons of quinine and cinchona

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[11] Memorandum vergadering Dagelijks Bestuur Kinabureau, 14 maart 1941, Item 8993, Archief NHM, Nationaal Archief, Den Haag.

[12] Concept verkorte notulen Kinabureau, 27 juni 1941, Item 8993, Archief NHM, Nationaal Archief, Den Haag.

[13] Memo Ras aan Leden van het Kinabureau, 29 juli 1943, Item 8993, Nationaal Archief, Den Haag.

[14] This is in contrast to other sectors of the economy. See, for example, Sluyterman 2005, 167-168, Goss 2011, 128 and Zwaag 1991.

[15] P.M. Prillwitz, *De Kinacultuur in Ned. – Indië tijdens de Japansche bezetting*, 15 augustus 1946, Colonial collection (KIT), Leiden University Library.

bark from the Netherlands Indies to Japan.[16] By 1948, one of the Cinchona Bureau's first priorities was to regain control over this large quantity of bark and quinine. The Cinchona Bureau made several requests to the Dutch Ministry of Foreign Affairs to send two quinine experts (members of the Cinchona Bureau) to Japan to "assess the situation in Japan in regard to what is necessary to settle the case […] and bring the [quinine and cinchona bark] under control of the Cinchona Bureau."[17] But, the Americans were not keen to let representatives of the Cinchona Bureau enter Japan. Ultimately, a solution was found to allow the Dutch mission in Japan to "quietly" send the bark and quinine cargos to Batavia where they would be handed over to representatives of the Cinchona Bureau.[18] The Cinchona Bureau in Amsterdam was not completely satisfied with this solution since the cargos were assigned to the Cinchona Bureau, but not safely stored in the Cinchona Bureau's warehouses in Amsterdam.

An important reason for this dissatisfaction was the changing political climate in the Indonesian Archipelago, which ultimately led to the recognition of the new Republic of Indonesia in 1949. Before the Second World War, the colonial state had been a reliable and trustworthy ally of the Cinchona Bureau. Through legislation, the colonial state had regulated and controlled the production and export of cinchona bark in the Netherlands Indies, hence aiding the dominance of the cinchona-quinine enterprise. Although the new Indonesian government did not change the legislation, its standpoint on cinchona cultivation was radically different from the former colonial government.[19] Instead of aiding the Dutch enterprise, the young Republic wanted to have complete control. So the Cinchona Bureau ordered to authorize its representative in Jakarta to "provide the Government of

[16] The amount was estimated to be 3.5 million dollars' worth of quinine and 425.000 dollars word of cinchona bark. W. Schilling, Luitenant-generaal en hoofd Nederlandse Missie in Japan, 18 juni 1948, Item 6436, Code-archief van het Ministerie van Buitenlandse Zaken, 1945-1954, Nationaal Archief, Den Haag.

[17] P. Leendertz aan A.H.J. Lovink, 13 juli 1948 and P. Leendertz aan A.H.J. Lovink, 23 juli 1948, Item 6436, Code-archief van het Ministerie van Buitenlandse Zaken, 1945-1954, Nationaal Archief, Den Haag.

[18] Chef Directe Verre Oosten aan Delegatie Kinabureau Batavia, 22 juli 1948, Item 6436, Code-archief van het Ministerie van Buitenlandse Zaken, 1945-1954, Nationaal Archief, Den Haag.

[19] In regard to the young Republic of Indonesia and Dutch enterprise in Indonesia in general, see (amongst others), Sluyterman 2005, 168, Lindblad 2010, 101 and Thee Kian Wie 2009, 20-24.

Indonesia all the information of which the Cinchona Bureau possesses and serve [the government] advice."[20] The cinchona-quinine enterprise was thus able to continue its activities in Indonesia, but had to acknowledge Indonesian control over cinchona cultivation.[21]

Another factor that disrupted Dutch control over the entire product chain was the emergence of cinchona cultivation in the Belgian Congo by the late 1930s and 1940s. On 22 September 1950, the Dutch newspaper *De Telegraaf* published an article with the headline "Congo breaks the Indonesian cinchona monopoly," describing how Indonesian cinchona bark (the raw material for the antimalarial medicine quinine) dominance had ended as a result of the emergence of a cinchona cultivation in the Belgian Congo.[22] In 1899, the Belgian colonial government had begun experimenting with cinchona cultivation in the Kivu region in eastern Congo, which remained generally experimental during the following decades.[23] By the 1930s, however, the Belgian government established an experimental field station in the Kivu region for the purpose of testing and experimenting with high quality seeds sent from the Netherlands Indies.[24] Led by a chemical engineer "who had spent several years on Java examining the mountain cultures [like cinchona]" and with the strong financial backing of the Belgian colonial government, these experiments resulted in highly competitive cinchona cultivation in the Belgian Congo by the 1940s.[25] Strongly stimulated by the war, the cultivation grew

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[20] Organisatie en werkzaamheden van het Kina-Bureau, 12-01-1953, Item 8999, Archief NHM, Nationaal Archief, Den Haag.

[21] In the case of Dutch scientists working in Indonesia, Goss has observed, "Dutch involvement […] was fine, as long as it acknowledged Indonesian control." Goss 2011, 139.

[22] *De Telegraaf*, 22 September 1950.

[23] "Le Quinquina au Congo Belge," in *Bulletin B.C.B.*, November 1954, 349-352, Item 9000, Archief NHM, Nationaal Archief, Den Haag.

[24] These seeds originated from one of the plantations of the Government Cinchona Estate as a result of negotiation efforts by the Belgian Prince Leopold. Rapport betreffende Ontwikkeling der kina-cultuur in den Belgischen Congo door de Consul-General te Leopoldville, 8 april 1944, Item 2997, Londons Archief, Nationaal Archief, Den Haag. According to Fiametta Rocco, these seeds were a gift from the Dutch princess Julianna to the Belgium King Leopold. Rocco 2003, 305.

[25] M.A. van Roggen, *Rappport Studiereis betreffende de Kinacultuur in Belgisch Congo, Mei/Juni 1949*, Colonial collection (KIT), Leiden University Library and, "Le Quinquina au Congo

exponentially from 200 tons in 1943 to more than 900 tons in 1948. With the emergence of this high quality Congolese cinchona bark, the German quinine manufacturers were no longer dependent on Dutch cinchona bark and were able to cast off the yoke of the Dutch cinchona-quinine enterprise.[26]

The change from a colonial government to a new independent Indonesian government and the appearance of the Congolese high quality cinchona cultivation had thus resulted in dramatic changes in the product chain from raw material to final product and hence the Dutch cinchona-quinine enterprise's control. The colonial agro-industrial system gave way to an agro-industrial system of multiple production sites and new centres of control (Indonesia, Congo, the German quinine industry, as well as the Cinchona Bureau). During the first half of the 1950s, the Dutch cinchona-quinine enterprise (via the Cinchona Bureau) nonetheless tried to regain control over the entire product chain and hold on to the colonial transoceanic networks of control.

Nationalization and changing production and trade networks in the 1950s

The shift of networks of control is well illustrated by a report from the Dutch Consul-General in Leopoldville, Congo (now Kinshasa), in November 1952, that included a conversation with the chairman of the Congo Cinchona Planters Association, Mr. De Beve. The report stated that this Mr. De Beve had made the impression that "he was not so certain anymore if the Cinchona Bureau was still in control over the market, production and sales of cinchona in Indonesia."[27] In the same conversation, De Beve also mentioned that the Indonesian government had proposed a convention because as the Indonesian Ambassador stated to De Beve, "it is not the Cinchona Bureau which controls the Indonesian cinchona market but the Indonesian government and hence it would

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Belge," in *Bulletin B.C.B.*, November 1954, 349-352, Item 9000, Archief NHM, Nationaal Archief, Den Haag.

[26] Prices of Quinine and Quinidine 1967.

[27] Consul-Generaal te Leopoldville aan Minister van Buitenlandse Zaken, 13 november 1952, Item 11725, Code-archief van het Ministerie van Buitenlandse Zaken, 1945-1954, Nationaal Archief, Den Haag.

be better for the Congo [planters] to deliberate directly with the Indonesian government."[28] In the Netherlands, however, these remarks were dismissed as nonsense by the director of the department of economic relations of the Ministry of Foreign Affairs, J.M.H. Timmermans. "They do not tally with the good relationship between the Indonesian government and the Cinchona Bureau, all the more because the interests of the Indonesian government and the Cinchona Bureau run parallel."[29]

Since Indonesia's independence in 1949, state officials had been questioning the Cinchona Agreement (the collaboration between the cinchona producers and quinine manufacturers) and hence the Cinchona Bureau's control of the Indonesian cinchona cultivation. They regarded the agreement as an obstacle to their improving Indonesia's market position for cinchona bark over the Congolese and sought to open up the Indonesian cinchona market by diminishing the Cinchona Bureau's control.[30] The Cinchona Bureau, however, regarded this option as a disastrous step for all worldwide cinchona markets. They argued, "if the supplier of a raw material had no monopoly position, it would have the weakest position in the economic interest battle with the buyers of the material, because these could go somewhere else if the prices would not please him."[31] Instead, the Cinchona Bureau opted for collaboration with the Congo cinchona planters in order to bring stability and control back to the international markets. The Cinchona Bureau believed that they were the institution with the most experience to handle such complex conventions and thus should have control. In this way, the Cinchona Bureau hoped to regain control over the worldwide supply of cinchona bark and henceforth the entire product chain from raw material to final product.

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[28] Consul-Generaal te Leopoldville aan Minister van Buitenlandse Zaken, 13 november 1952, Item 11725, Code-archief van het Ministerie van Buitenlandse Zaken, 1945-1954, Nationaal Archief, Den Haag.

[29] J.M.H. Timmermans aan Minister van Economische Zaken, 24 december 1952, Item 11725, Code-archief van het Ministerie van Buitenlandse Zaken, 1945-1954, Nationaal Archief, Den Haag.

[30] Memorandum van de vergadering van het Dagelijks Bestuur van het Kina-Bureau, 5 augustus 1955, Item 8999, Archief NHM, Nationaal Archief, Den Haag.

[31] Memorandum van de vergadering van het Dagelijks Bestuur van het Kina-Bureau, 5 augustus 1955, Item 8999, Archief NHM, Nationaal Archief, Den Haag.

In 1951, an agreement was signed between the Cinchona Bureau and the largest cinchona planters association in the Congo, the *Société Coopérative "Congokina."* The objective was to stabilize international markets and to "avert that the Congo, with her continuously raising production, would be a direct competitor for Indonesia on the worldwide markets."[32] In other words, the Cinchona Bureau's collaboration with Congokina was aimed at re-establishing colonial networks of control by centralizing the worldwide supply at the Cinchona Bureau. However, the collaboration was not successful and by 1955, the Cinchona Bureau ended the agreement due to Congokina's non-compliance with production quotas and price agreements (for example, barks had been sold to parties outside the agreement) and Congokina's financial liability.[33] Based on the assumption that Indonesian cinchona cultivation would not regain its former position, Congokina had invested heavily in expanding cinchona production and built its own quinine factory, Pharmakina in Bukavu. Unfortunately, declining demand for quinine as a result of the growing demand for synthetic antimalarial medicines turned out to be disastrous for Congokina. Nevertheless, Congokina's management had repeatedly stated to the Cinchona Bureau that Congokina's existence was assured.[34] Ultimately, the Dutch ambassador in Brussels reported to the Minister of Foreign Affairs, "the management of the Cinchona Bureau in Amsterdam should need to realize, that despite what Congolese cinchona planters are saying, the liquidation [of Congokina] is a fait accompli."[35]

By 1954, the Belgian government took over the Congolese quinine factory and the Congokina cooperative gradually fell apart.[36] However, the Belgian government had no intention of managing the factory and plantations it had taken over from Congokina. They tried to sell these assets to the Belgian firm, Union Chimique Belge (part of the Solvay group), but without result. Thereafter, German

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[32] P.A. Waller, "Kina-politiek," NHM 8999 and "Le Quinquina au Congo Belge," in *Bulletin B.C.B.*, November 1954, 349-352, Item 9000, Archief NHM, Nationaal Archief, Den Haag.
[33] P.A. Waller, "Kina-politiek," Item 8999, Archief NHM, Nationaal Archief, Den Haag.
[34] Bespreking te Brussel met Mr. Sharff, 13 maart 1953, Item 9000, Archief NHM, Nationaal Archief, Den Haag.
[35] Ambassadeur te Brussel aan de Minister van Buitenlandse Zaken, 5 mei 1953, Item 11725, Code-archief van het Ministerie van Buitenlandse Zaken, 1945-1954, Nationaal Archief, Den Haag.
[36] "Le Quinquina au Congo Belge," in *Bulletin B.C.B.*, November 1954, 349-352, Item 9000 Archief NHM, Nationaal Archief, Den Haag.

companies like Bayer and Buchler showed interest, but according to the Dutch ambassador in Brussels, the Belgian government was not willing to have German interests in the Belgian Congo. So, the Dutch ambassador in Brussels suggested to the Ministry of Foreign Affairs that if the Cinchona Bureau was not interested in buying the Congolese assets from the Belgian government, "Would it not be wise if the Dutch would already associate themselves with another supplier of cinchona than Indonesia?"[37] In the end, the Cinchona Bureau did not take action and by 1955, the Congolese factory and several plantations were sold to the German pharmaceutical company, C.F. Boehringer & Söhne.[38]

An important reason why the Cinchona Bureau did not become directly involved in the Congolese cinchona cultivation was the revitalization of the Dutch quinine industry on international quinine markets by the mid-1950s. In early 1954, the director of the NKF and member of the Cinchona Bureau, Ir. J. Homan van der Heide, informed his fellow members of the Cinchona Bureau that Nedchem (see table 10) had been able to improve its position on the United States market. As a result, German companies were showing renewed interest in collaborating with the Dutch and talks were opened with the two largest German quinine manufacturers Buchler & Co. and Boehringer.[39] In a meeting of the Cinchona Bureau, representatives of the quinine manufacturers emphasised the goal of the talks by stating, " we have to avoid that these manufacturers [the Germans] will buy their barks in Congo" and second, "the higher the number of manufacturers committed to the [Cinchona Producers] Association, the more advantages this has for her [the Association]."[40]

Thus, the Dutch still believed in a revival of their pre-war colonial networks of control in which the Cinchona Bureau would once again be the decision-making centre for controlling international cinchona and quinine markets.

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[37] Ambassadeur te Brussel aan de Minister van Buitenlandse Zaken, 9 februari 1954, Item 11725, Code-archief van het Ministerie van Buitenlandse Zaken, 1945-1954, Nationaal Archief, Den Haag.

[38] Boehringer produced quinine in the Congo until 1997, when the whole company was taken over by the Swiss pharmaceutical firm F. Hoffmann-La Roche. Rocco 2003, 306-308. See also Prices of Quinine and Quinidine 1967.

[39] Memorandum van de vergadering van het Dagelijks Bestuur van het Kina-Bureau, 24 februari 1954, Item 9000 Archief NHM, Nationaal Archief, Den Haag.

[40] Memorandum van de vergadering van het Dagelijks Bestuur van het Kina-Bureau, 24 februari 1954, Item 9000, Archief NHM, Nationaal Archief, Den Haag.

In 1955, for example, the representative of the Cinchona Bureau in Jakarta, H.J. Gorter, strongly advised Kaslan A. Tohir, chairman of the Commission for Cinchona Affairs of the Ministry of Agriculture of the Indonesian government, to abandon the policy of stocking cinchona bark in Indonesia and instead send it to the Cinchona Bureau in Amsterdam. Or else, he warned, "[quinine] manufacturers would not have quick access to the raw material" and henceforth, Indonesian cinchona cultivation would not only offer a poorer product, but also provide less service than cinchona cultivators in the Congo. He added that because of the failure of the Dutch collaboration with Congokina, "a fierce competition between these two production areas" is now a reality.[41] In other words, holding on to the Cinchona Bureau system would be beneficial for both the Dutch and the Indonesians.

At the same time, however, the Indonesian government was working to change this colonial agro-industrial system of control that required that the cinchona bark be shipped to Amsterdam before being sold to the quinine manufacturers.[42] For example, the Indonesian representatives in Brussels were actively lobbying the Belgian government and the Congolese cinchona producers to come to an agreement independent of the Cinchona Bureau. By 1957, the Dutch ambassador in Brussels reported that the Indonesian representative had informed the Belgian Minister of Colonies to be "prepared to make direct contacts regarding the subject of cinchona between Indonesia and the Belgian Congo, preferably without the Dutch."[43] The Belgian government was quite willing to discuss these matters with the Indonesians. Belgian officials were already raising questions in 1953, asking whether it was possible to persuade the Indonesian government to have more active collaboration with the Congolese cinchona cultivators, "if the Cinchona Bureau would lose its Dutch hallmark and would be

[41] H.J. Gorter aan Ir. Kaslan A. Tohir, 12 november 1955, Item 11860, Code-archief van het Ministerie van Buitenlandse Zaken, 1955-1964, Nationaal Archief, Den Haag.
[42] Telegram Ministerie van Buitenlandse Zaken aan Djakarta, 14 november 1955, Item 11860, Code-archief van het Ministerie van Buitenlandse Zaken, 1955-1964, Nationaal Archief, Den Haag.
[43] Ambassadeur te Brussel aan Minister van Buitenlandse Zaken, 3 april 1957, Item 11860, Code-archief van het Ministerie van Buitenlandse Zaken, 1955-1964, Nationaal Archief, Den Haag.

located elsewhere, for example Brussels, without the Dutch."[44] So, whereas the Cinchona Bureau believed in a revival of their position of control over the Indonesian cinchona cultivation, the Indonesian government had quite other intentions. As the Dutch ambassador in Brussels saliently remarked in April 1957, "I fear the managers of the Cinchona Bureau in Amsterdam are making too much an illusion of the real intentions of the Indonesian authorities."[45]

These intentions became harsh reality when on 5 December 1957, Indonesian labour union members, students and soldiers began seizing control of Dutch enterprises and businesses.[46] On 18 December 1957, the members of the Cinchona Bureau were informed that the Bureau's office in Jakarta had been taken over by state officials of the Indonesian Department of Agriculture and that students and soldiers had seized several cinchona plantations.[47] Although it took almost a year for the Indonesian government to legalise the seizures and declare a complete nationalization of all Dutch businesses, this had already taken place for cinchona by the summer of 1958. The Indonesian government, eager to take complete control over the cinchona cultivation, had used the seizures to contract with the British trading firm Francis Peek & Co. making it the only company allowed to export cinchona bark from Indonesia.[48] In other words, by mid-1958 the Cinchona Bureau had lost control over Indonesian cinchona cultivation and had become completely dependent on the exports of this British trading firm and their client, the Indonesian government.

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[44] Bezoek A. Dommering aan de Nederlandse ambassade te Brussel, 13 maart 1953, Item 9000, Archief NHM, Nationaal Archief, Den Haag.

[45] Ambassadeur te Brussel aan Minister van Buitenlandse Zaken, 3 april 1957, Item 11860, Code-archief van het Ministerie van Buitenlandse Zaken, 1955-1964, Nationaal Archief, Den Haag.

[46] These were the result of building tensions between the Dutch and Indonesian governments regarding the status of the remaining Dutch possession or West Irian (Papua). Thee Kian Wie 2009, 29-30 and Lindblad 1997, 97.

[47] Memorandum van de vergadering van het Dagelijks Bestuur van het Kina-Bureau, 18 december 1957, Item 8999, Archief NHM, Nationaal Archief, Den Haag.

[48] Memorandum vergadering Dagelijks Bestuur Kinabureau, 21 augustus 1958, Item 8999, Archief NHM, Nationaal Archief, Den Haag.

Table 10: The main organizations and companies involved in the cinchona and quinine business during the 1940s-1950s.

Company	Location	Activity
Cinchona Bureau (1913-1960s)	Amsterdam, the Netherlands	Decision-making organization of the Dutch transoceanic cinchona-quinine enterprise (ca. 1918-1950s).
N.V. Nederlandsche Combinatie voor Chemische Industrie (Nedchem) (1920-1967)	Amsterdam, the Netherlands	Joint venture of the ACF, BKF and NKF for the joint purchase of cinchona bark and marketing of quinine products & member of the Cinchona Bureau.
Cinchona Producers Association (1927-1960s)	Amsterdam, the Netherlands	The umbrella organization of the approximately 120 Dutch cinchona planters and traders (producers) & member of the Cinchona Bureau.
N.V. Amsterdamsche Chininefabriek (1881-1967)	Amsterdam, the Netherlands	The oldest Dutch quinine company. Member of the international quinine cartel, the Cinchona Bureau and Nedchem.
N.V. Bandoengsche Kininefabriek (1896-1958)	Bandung, Indonesia	Established in the Netherlands Indies by a cooperative of cinchona planters and the Dutch colonial government. Nationalized in 1958 and today part of Kimia Pharma.
N.V. Bandoengsche Kininefabriek (1953-1967)	Amsterdam, the Netherlands	Dutch split off of the company in Bandung.
N.V. Nederlandsche Kininefabriek (1903-1967)	Maarssen, the Netherlands	Member of the international quinine cartel, the Cinchona Bureau and Nedchem.
C.F. Boehringer & Sohne (1859-1997)	Mannheim, Germany	German pharmaceutical company, one of the first mass producers of quinine and leading company in the international quinine cartel.
Chininfabrik Braunschweig Buchler & Co.	Braunschweig, Germany	German pharmaceutical company and today the largest quinine manufacturer in the world.
Societe Cooperative "Congokina" (1940-1955)	Bukavu, Congo	Cooperative of cinchona planters in the Belgian Congo.
Francis Peek & Co.	London, Great Britain	Trading house in tropical agricultural products.

In contrast to what the Dutch were thinking in the mid-1950s, the process of the shifting networks of control had not been reversed. On the contrary, by the late 1950s, control of Indonesian cinchona cultivation was now firmly in the hands of the Indonesian government. Meanwhile, the German quinine manufacturers continued to buy Congolese cinchona (Boehringer even had their own Congolese cinchona plantations) and hence remained outside the Cinchona Bureau's control. The pre-war colonial agro-industrial system was becoming a thing of the past and was gradually replaced by an industrial agro-industrial system based on new international networks of control with new centres of control.

New networks of control and the shift from colonial agro-industrialism to agro-industrialism (ca. 1960s)

With the Dutch loss of control over Indonesian cinchona cultivation in 1959, "the [quinine] manufacturers and the Cinchona Producers Association […] agreed to give the manufacturers permission to buy [cinchona] bark wherever they want."[49] At first, the Cinchona Bureau only granted this permission to the Dutch quinine manufacturers for the years 1959 and 1960. The cinchona producers in Indonesia still had high hopes that although the old situation would not return, the Indonesian government would at least continue to export cinchona bark to the Cinchona Bureau in Amsterdam. The chairman of the Cinchona Bureau, for example, stated during a meeting in September 1959:

> "I am aware that the Cinchona-Agreement and the Cinchona Bureau do not have the importance anymore of thirty years earlier. Nonetheless, in the current circumstances the Cinchona-Agreement still has a useful function for the joined parties and maintaining it still provides some evident advantages for both parties."[50]

[49] Notulen van de gecombineerde vergadering van het Kina-Bureau en het Bestuur van de Vereeniging van Kinabast-Producenten, 25 februari 1959, Item 9001, Archief NHM, Nationaal Archief, Den Haag.

[50] Notulen gecombineerde vergadering van het Kinabureau en de Vereeniging van Kinabast-Producenten, 22 september 1959, Item 9001, Archief NHM, Nationaal Archief, Den Haag.

This optimism was based on the fact that during the first two years, Francis Peek & Co. made "satisfactory" shipments of cinchona bark to the Cinchona Bureau, "which shows trust for the future."[51] However, by the mid-1960s, circumstances had changed for the worse when the Indonesian government began selling cinchona bark to parties outside the Cinchona Bureau. In addition, Francis Peek & Co. had begun supplying cinchona bark to other quinine manufacturers like the German company Buchler & Co. In a meeting with Francis & Peak in July 1960, the Dutch expressed "shock" at this change of events. They made it clear to Francis Peek & Co. that they regarded them as their "confidential agent" and "we had expected that they would never do this [supply other quinine manufacturers], that they at least would have informed us regarding their intentions."[52] The British responded that they did not regard themselves as the confidential agent of the Cinchona Bureau, but rather as the agent of the Indonesian authorities and that the Dutch had no right to know their intentions.

The shocked response of the Dutch and the reserved reaction of Francis Peek & Co., nicely illustrates how the Cinchona Bureau had completely lost decision-making powers and control over Indonesian cinchona cultivation by 1960, and henceforth its role on the international markets. Without cinchona bark to supply to the quinine manufacturers, the core business of the Cinchona Bureau (which had given it such powerful controlling authority during the pre-war decades) had ceased to exist. This coincided with a definitive falling apart of the Dutch transoceanic cinchona-quinine production and trade network. By December 1960, the chairman of the Cinchona Bureau announced that by November the last stocks of cinchona bark had been allotted to the quinine manufacturers and after the last consignments of cinchona bark had been settled with Francis Peek & Co., "a large part of the activities of the staff of the Cinchona Bureau would end."[53] From January 1961, the Cinchona Bureau would abandon its seat at the Lairessestraat in Amsterdam and move their office to the headquarters of D.C. & M. Watering & Co., a Dutch trading company and one of the largest cinchona

[51] Notulen vergadering Vereeniging van Kinabast-Producenten, 23 december 1959, Item 9001, Archief NHM, Nationaal Archief, Den Haag.
[52] Kort verslag van een bespreking met Francis Peek & Co. te Londen, 1 juli 1960, Item 9001, Archief NHM, Nationaal Archief, Den Haag.
[53] Voorzitter aan Heren Leden en Plv. Leden van het Kina-Bureau, 20 december 1960, Item 9001, Archief NHM, Nationaal Archief, Den Haag.

producers, "to finish off the last activities."[54] Although the Cinchona Bureau was not relinquished, its activities were downgraded, the Cinchona Laboratory was liquidated and their offices held since 1913 were abandoned. These were all clear signs that an end was coming to the decades-long collaboration between the cinchona producers and the quinine manufacturers centred on this once world-leading institution in the field of cinchona and quinine. In February 1961, the quinine manufacturers informed the cinchona producers, "With the stocks [of cinchona bark] of the [Cinchona Producers} Association exhausted, an end has come to her supplies and it is therefore no surprise that the manufacturers have taken the standpoint that at present an end has come [to our cooperation]."[55]

After more than five decades, the close collaboration between the cinchona producers and the quinine manufacturers within the Dutch cinchona-quinine enterprise was over by the early 1960s. At the same time, the Dutch quinine manufacturers had managed to position themselves at the forefront of the international quinine markets by opening alternative and flexible networks of raw material supply, and thereby transforming the colonial agro-industrial system into an agro-industrial system. One central aspect that had changed considerably on the international markets after the Second World War and contributed to the shifting networks of control was the rapidly declining role of quinine as an antimalarial medicine. As mentioned, significant funding from the United States government had resulted in the rapid development of safe and effective synthetic antimalarial medicines like atebrine and chloroquine.[56] This meant that the quinine industry was eager to find new markets for quinine and develop new medicines based on quinine. One of these new quinine medicines was quinidine (a chemical extraction from quinine), which was used in the treatment of cardiovascular diseases (or "disorders of the heart").[57] By the late 1950s, the Dutch quinine industry (the Nedchem combination) and the German manufacturer Boehringer were the two

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[54] Voorzitter aan Heren Leden en Plv. Leden van het Kina-Bureau, 20 december 1960, Item 9001, Archief NHM, Nationaal Archief, Den Haag.

[55] N.V. Nederlandsche Combinatie voor Chemische Industrie aan de Vereeniging van Kinabast-Producenten, 7 februari 1961, Item 9001, Voorzitter aan Heren Leden en Plv. Leden van het Kina-Bureau, 20 december 1960, Item 9001, Archief NHM, Nationaal Archief, Den Haag.

[56] Webb 2009, 156-159 and chapter 6.

[57] Gold 1929.

largest quinidine producers and suppliers in the world.[58] Furthermore, quinine became a much-in-demand ingredient for tonic production. Since the nineteenth century, quinine had been used in the production of tonics with branded names like *Schweppes Indian Tonic* and *Kina Lillet* (today known as *Lillet Blanc*).[59] During the 1950s and 1960s, the quinine market was gradually becoming a mixed market. However, control over the international markets (setting prices and controlling sales) was seen to be necessary as it had been before the war and this meant control over the entire product chain from raw material to final product.

In 1956, the three Dutch manufacturers – the ACF, NKF and BKF – decided to reorganise their collaboration and strengthen their joint venture, Nedchem. By 1953, the BKF was already split into a Dutch and an Indonesian business, with the Dutch business forming a partnership with the ACF and NKF.[60] Second, the BKF's activities were diversified between two production sites. The bulk production of the semi-finished product of quinine sulphate was concentrated on the premises of the NKF in Maarssen, south of Amsterdam, while the production of fine chemicals was to remain on the ACF premises in Amsterdam. Distribution activities were housed in a new subsidiary, the N.V. Pharmaceutische Groothandel. Third, the various laboratories that had been organized in the NKF and ACF by the late 1930s were brought together in the aforementioned Nedchem, located in Amsterdam.[61] Last, but not least, more emphasis was placed on the production of other medicines, like sulphonamides, anti-coagulants and iodine, which had begun slowly during the 1930s.[62] By bringing these various parts of the production and distribution of quinine into a more tightly controlled organization, the Dutch quinine manufacturers anticipated new international developments and the scaling-up that occurred during the 1950s in the

[58] Memorandum vergadering Dagelijks Bestuur Kinabureau, 24 februari 1954, Item 8999, Voorzitter aan Heren Leden en Plv. Leden van het Kina-Bureau, 20 december 1960, Item 9001, Archief NHM, Nationaal Archief, Den Haag, *Prices of Quinine and Quinidine* 1967, 3-4 and Heuschen 1998, 45-46.

[59] Streller und Roth 2012, 243-245.

[60] *De Telegraaf*, 11 December 1958.

[61] Memorandum vergadering Dagelijks Bestuur Kinabureau, 6 januari 1956, Item 8999, Voorzitter aan Heren Leden en Plv. Leden van het Kina-Bureau, 20 december 1960, Item 9001, Archief NHM, Nationaal Archief, Den Haag.

[62] Heuschen 1998, 45, Bon en Snel 2002 and interview with Tjeerd Homsma on 13 August 2014, who worked as a chemist for ACF between 1965 and 1990.

pharmaceutical and chemical industries.[63] Furthermore, they were able to act more strongly as one group and position themselves within the changing networks of control regarding cinchona and quinine markets.

Therefore, when Dutch collaboration with Congokina failed to secure the control over worldwide cinchona cultivation through the Cinchona Bureau by the mid-1950s, Nedchem's management turned to the United States where a year earlier the government had announced the sale of their quinine stockpile of 13,8 million ounces (approximately 400.000 kilograms) "on the grounds that new synthetic antimalarials had made quinine obsolete."[64] Based on the small international quinine and quinidine markets, this United States stockpile represented a large pool of raw material that could provide the Dutch with new alternative sources of raw material apart from the Indonesian cinchona bark and hence control over the international quinine markets. As a memorandum of the General Service Administration (GSA) (the USA federal agency entrusted with selling the stockpile) stated in 1956, "If the Dutch were to purchase the stockpiled quinine it would mean that no bark from the Dutch East Indies [e.g. Indonesia] would be required for many years until the U.S. Government stocks have been worked up and sold."[65]

However, the purchase of this stockpile proved to be more complex than anticipated. The Dutch initiated the establishment of an international quinine cartel in 1959, to ensure that this precious source of raw material was not broken up into small parts and sold to various parties thus diminishing Dutch control. In collaboration with the German manufacturer Boehringer, Nedchem cunningly constructed a cartel in which three British and four French manufacturers agreed not to bid on the United States' stockpile in return for a share in the stockpile and raw material from Indonesia and Congo, which by 1959 were still largely controlled by Nedchem and Boehringer respectively.[66] In 1962, Nedchem succeeded in buying four-fifths of the stockpile and hence secured an important source of raw material. By this time, however, Nedchem had liquidated the cartel and the stockpile was only shared with the German company Boehringer. An important

[63] See for example Homburg, van Selm and Vincken 2000 and Vermij 2010.
[64] Prices of Quinine and Quinidine 1967, 49.
[65] Prices of Quinine and Quinidine 1967, 50.
[66] Prices of Quinine and Quinidine 1967, 3-8.

reason for Nedchem to break up the cartel was that the cartel was supposedly supplying Indonesian cinchona bark to British manufacturers and another German manufacturer, Buchler & Co. in 1961. In a meeting in 1961, the Dutch became "furious" when they heard that one of the British manufacturers had bought quinine from Bandung and "forced it to turn it over to the Convention to be shared."[67] However, British and German manufacturers' purchases of Indonesian cinchona bark, which the Dutch still regarded as theirs despite the loss of control three years earlier, gave Nedchem a reason not to share the stockpile and hence they maintained control of this important source of raw material.

In addition to the United States' stockpile, by the 1960s Nedchem began to build other networks of control through the acquisition of cinchona plantations in Congo, Ruanda and Guatemala and the purchase of totaquina, a crude form of quinine from the Boehringer owned Pharmakina factory in Bukavu, Congo.[68] By 1963, Nedchem had bought approximately 800 hectares of cinchona plantations in the Congo and Ruanda, of which 100 hectares were planted with cinchona trees through a "sound policy of maintenance" by 1965.[69] Through a process of plant breeding, agronomists in the service of Nedchem were able to improve the quality of the cinchona bark product on these African plantations in time for quinidine production, which by the early 1960s had become the most attractive quinine derivate medicine to produce.[70] Furthermore, by the mid-1960s, Nedchem was collaborating with Buchler & Co. to buy the old cinchona plantations in Guatemala that had been established by the American pharmaceutical company Merck & Co. and the US Department of Agriculture during the 1930s.[71] So, in the 1960s, the Nedchem combination, which had merged into one holding group called the Amsterdamse Chemie Farmacie (ACF) in 1967, succeeded in integrating agricultural production sites of cinchona bark in Africa and Central America into

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[67] Prices of Quinine and Quinidine 1967, 28.

[68] N.V. Nederlandsche Combinatie voor Chemische Industrie aan de Vereeniging van Kinabast-Producenten, 7 februari 1961, Item 9001, Voorzitter aan Heren Leden en Plv. Leden van het Kina-Bureau, 20 december 1960, Item 9001, Archief NHM, Nationaal Archief, Den Haag, Heuschen, "Maarssen en de Nederlandsche Kininefabriek NKF (1905-1967)," 46-47 and De Telegraaf, 12 April 1986.

[69] *De Tijd De Maasbode*, 28 July 1965 and *De Tijd*: dagblad van Nederland, 14 February 1967.

[70] Interview with Tjeerd Homsma, 13 August 2014 and De Tijd De Maasbode, 28 July 1965.

[71] Heuschen 1998, 46-47 and Prices of Quinine and Quinidine 1967, 3.

their industrial complexes and take control over the entire product chain from raw material to final product.

Conclusion

In their study about networks and agricultural globalization, Busch and Juska have argued that as a result of contemporary advances in telecommunication and transportation technologies, multinational corporations have been increasingly dominant in agriculture, the restructuring of production processes and the creation of new forms of competition among suppliers of primary products.[72] Three closely linked reasons illustrate how this chapter fits Busch and Juska's argument and show how through a similar process of globalization, colonial networks of control were replaced by new industrial networks of control and a colonial agro-industrial system was reconfigured into an agro-industrial system.

First, the networks within the entire product chain from raw material (cinchona bark) to final product (quinine) changed from the 1940s to the 1960s. Before the Second World War, the product chain was built on access to only one raw material production site: cinchona cultivation in the Netherlands Indies. With the emergence of new production sites in the Congo and Central America, however, raw material production sites became less central in the product chain. In this way, the connections between the various links in the chain from cultivation to sales became looser and this resulted in new forms of competition among the suppliers of the primary product of cinchona bark. This process of globalization of the raw material (agricultural) sites was hence strongly influenced by the Japanese occupation of the Netherlands Indies and the following decolonization of Indonesia. Not only was the Dutch transoceanic network isolated during the Second World War, due to the Japanese occupation and control of cinchona cultivation in the Netherlands Indies, Congolese cinchona cultivators were strongly motivated to improve and expand their high quality cinchona bark production. The subsequent process of Indonesian economic decolonization and de-globalization of Dutch business networks in Indonesia during the 1950s further stimulated this process of (agricultural) globalization.

[72] Busch and Juska 1997, 694.

Second, ownership of agricultural cinchona bark production gradually shifted to the quinine industry. Whereas, initially, the cinchona producers controlled the production site of cinchona bark in alliance with the Cinchona Bureau, by the late 1950s, the quinine industry had taken control over the product chain. The Indonesian decolonization process of the 1950s and the Dutch cinchona producers' loss of control over Indonesian cinchona cultivation both influenced the change in control of the product chain. These events resulted in the disintegration of the close collaboration between the cinchona producers and quinine manufacturers within the Cinchona Bureau and the colonial transoceanic agro-industrial system or network.

Third, the shift in industrial priorities to production and marketing of the final product from a focus on raw material access commercialized the agro-industrial system such that the price of the raw material became more important than its geographic location. In this sense, distribution lines between the Congo and Europe were commercially shorter and more profitable than the longer lines between Indonesia and Europe. This was strongly influenced by the changing economy of scale in both the Dutch and international quinine industry. During the 1950s, the three Dutch quinine manufacturers strengthened their cooperation by further integrating the production and distribution processes and hence gradually emphasised the production and marketing of the final product over access to raw material. At the same time, three pharmaceutical companies began to strongly dominate the international quinine industry: the ACF in the Netherlands and Buchler & Co. and Boehringer in Germany.

Conclusion

In the autumn of 1930, the director of the Government Cinchona Estate, Mathieu Kerbosch, presented a lecture during the "Celebration of the Three Hundredth Anniversary of the First Recognized Use of Cinchona" at the Missouri Botanical Garden in St. Louis, United States. The main purpose of his lecture titled "Cinchona Culture in Java. Its history and present Situation," was to show his audience that the Dutch colonial dominance of the cinchona markets was not an artificial but rather a "natural" outcome, "created by science and maintained by perseverance [of the planter]."[1] In other words, according to Kerbosch, the success of the Netherlands Indies cinchona cultivation was the self-evident result of the close interaction between science and agro-industry in a colonial context. But, how self-evident and natural was this outcome?

In this thesis, I have shown that what was regarded as the natural outcome of 'scientific perseverance' in 1930, required decades of hard work between bench, field and boardroom in order to spur the coevolution of commercial gain, scientific knowledge, and agro-industrial production within the realm of the Dutch colonial empire. This process is branded as colonial agro-industrialism. Through a dynamic process of knowledge exchange, innovation, and economic cooperation, a transoceanic network of cinchona planters and traders, quinine industrialists and state-sponsored scientists was established and succeeded in gaining international control over the production and distribution of the raw material cinchona bark. Henceforth, this network came to play a dominant role in the first global pharmaceutical cartel that controlled the industrial production and distribution of the antimalarial medicine quinine.

As set forth in the introduction, this thesis makes a strong contribution to the well-worn, extensive and foremost medical historiography regarding quinine (and malaria) and a 'forgotten' chapter in Dutch pharmaceutical history. Quinine (and malaria) has been subject of many historical and scientific studies; however, the agro-industrial development, production and distribution of cinchona bark and quinine have remained a rather neglected subject. Quinine has been a favourite subject of historical research regarding British (medical) governance in British India during the nineteenth and early twentieth centuries or as an example of an

[1] Kerbosch 1930a, 199 and Kerbosch 1931b, 335.

industrial mass product of the nascent American pharmaceutical industry. As mentioned in the introduction, an important reason for the neglect of the specific Dutch role in the agro-industrial production of this antimalarial medicine has been a language barrier. By using extensive primary material from Dutch archives, this thesis has added an important new chapter to the international quinine (and) malaria historical narrative. The thesis opens a new window on how the Dutch quinine and cinchona historical trajectories played out at the intersection of scientific medicine, colonialism and (pharmaceutical) industry within a global context. As such, this thesis differs fundamentally from Goss' studies on the Dutch cinchona and quinine industry. In his studies on the Dutch cinchona cultivation, Goss' focus is on the historical narrative of Dutch colonialism and the role of science as an instrument of colonialism. Henceforth, Goss only touches briefly on the development of the European (German and Dutch) pharmaceutical industry and the central role of the laboratory as a quality control device across a transoceanic network.

This thesis makes a fundamental contribution to the Dutch historiographies of science and technology, as well as industrialization and colonialism, by showing the necessity of closely connecting Dutch colonial history with Dutch industrial history in the late nineteenth and early twentieth centuries and vice versa. In the opening chapter of *Technology and the making of the Netherlands,* Schot and Rip have stated that, amongst other factors, Dutch industrialization by the late nineteenth century exploited the availability of a large colonial trading network.[2] With exception of the chapter written by Harro Maat, this volume on science and technology and the development of the Dutch modern industrial nation state does not comprehensively take into account how colonial agricultural (raw material) production sites and hence trading networks contributed to the industrialization of the Netherlands. A similar omission can be argued for Dutch colonial history. Although in the last decades multiple studies have been conducted regarding Dutch colonial practice, and as valuable as these studies are, they miss the strength of connecting these three historical narratives. Thomas Lindblad, one of the most distinguished colonial historians, for example, has extensively studied the economic and political development of the Netherlands Indies and postcolonial Indonesia and connects these developments with those in the Netherlands and former motherland. However, his work and that of his peers do

[2] Schot, Lintsen and Rip 2010.

not comprehensively take into account how science and technology and the Dutch industrial nation state contributed to Dutch colonial and postcolonial practices in the Netherlands Indies and vice versa.[3] This thesis has taken up the challenge and shows that by connecting three hitherto separate historical narratives – the historical development of the Dutch industrial nation state, the history of science and technology and Dutch colonialism and imperialism – we can uncover links that operated across the formal borders of imperial and industrial formations and open up novel spatial frameworks.[4]

Four main arguments were put forward in this thesis on how the Dutch succeeded in forging relations across colonial, scientific and industrial frameworks within the realm of the Dutch colonial empire in the late nineteenth and early twentieth centuries by building a Dutch cinchona-quinine transoceanic enterprise. First, this thesis has shown how the employment of the laboratory as a new device materialized within the colonial context of agricultural and industrial production of raw materials (cinchona bark), semi-finished product (quinine sulphate) and plant-based medicines like quinine in both the Dutch and British Empires during the second half of the nineteenth century. As shown in the first chapter, in the Dutch case, the introduction of a quality control laboratory at the Government Cinchona Estate created an autonomous agricultural field station where the latest know-how was put into practice for crop innovation. As such, the vectors of assemblage provided the institutional and physical framework for communication, exchange and control, representing an early example of commodification of colonial science. In this way, the state-sponsored scientists at the Government Cinchona Estate created new knowledge and a new acculturated cinchona species that fit the laboratory-guided standardization and quality control efforts in the pharmaceutical industry.

Second, the formation of a Dutch cinchona-quinine transoceanic network by the first decade of the twentieth century was pivotal in shifting the balance of control and power over a delicately balanced supply chain from raw material to the final product from the German pharmaceutical industry to the Dutch cinchona and quinine-sulphate industry. As argued in the second chapter, the historical trajectories of cinchona and quinine-sulphate production and distribution in the

[3] Dick et al 2002 and Lindblad and Post 2009.

[4] Potter and Saha 2015.

Dutch empire show how laboratory science and the transoceanic circulation of knowledge played an important role in connecting the colonial cinchona bark cultivation with the quality and standardized pharmaceutical production of quinine sulphate and quinine medicines. In the process of connecting the colonial world of planters and cinchona traders with the European industrial hemisphere of pharmaceutical companies and state-of-the-art laboratories, two distinct networks of interest were integrated into a transoceanic colonial agro-industrial network of (colonial) scientists, traders, industrialists and state officials. The establishment of the transoceanic network resulted in enhanced control over the cinchona and quinine cartel and ultimately in the signing of the second Cinchona Agreement and the formation of a Dutch-controlled Cinchona Bureau by 1918.

Third, the development of the Cinchona Bureau as the decision-making centre of a international pharmaceutical cartel during the interwar period can be regarded as the ur-example of the burgeoning global pharmaceutical trade, and the global inequalities that emerged from and were reinforced by a pharmaceutical cartel. The Dutch-led international cartel was able to capitalise on one of the first international public health campaigns to fight malaria led by the League of Nations, thereby promoting the sale of quinine drugs in the fight against malaria at the expense of other community-based malaria control techniques and strategies. In addition, the control of an essential medicine and the privileging of marketing over science resulted in a diminished incentive for scientific innovation and a curtailment of the free circulation of knowledge. The strategic engineering of the transoceanic circulation of knowledge insidiously undermined innovation and ultimately posed a threat to Dutch market dominance in the post-war period.

The fourth argument concerns the simultaneous process of decolonization and globalization of the agricultural production sites of cinchona bark and how this created new networks of control for the entire product chain and a reconfiguration of a colonial agro-industrial system into an agro-industrial system. As shown in chapter four, colonial networks of control were replaced by new industrial networks of control and ultimately the colonial agro-industrial system was reconfigured into an agro-industrial system. As a result, the worldwide Netherlands Indies/Indonesian dominance of the cinchona bark supply came to an end. At the same time, industrial control by a select group of international industrial companies over the product chain from raw material to final product was strengthened.

By closely looking at how this dynamic process of cooperation, innovation and exchange – branded as colonial agro-industrialism – resulted in establishing a Dutch transoceanic cinchona-quinine network, this thesis provides two new fundamental historiographic insights into how the domains science, industry and state interacted, cooperated and exchanged knowledge across spatial frameworks. First, using the Dutch cinchona-quinine example, this thesis offers a unique insight into the dynamics of the relationships among the pharmaceutical industry, biomedical science, and international public health during an embryonic period for all three fields. It shows how the circulation of knowledge, standardization and cartelization were central themes in the evolution of a transoceanic agro-industrial enterprise during the late nineteenth century and first half of the twentieth century. In addition, the inclusion of the laboratory as a quality device in both the agricultural cinchona bark and industrial quinine production and distribution can be regarded as an example of a global industrial laboratory revolution.

In the first chapter, I showed how the demands for standardization, rationalization and efficacy by the nascent "ethical" pharmaceutical industry dramatically affected the development, production and distribution of the Netherlands Indies' cinchona and vice versa the development, production and distribution of the semi-finished and finished drug components quinine sulphate and quinine. The German pharmaceutical industry, which by the 1870s had grown into the most important and largest industry of its kind in Europe, was keen on creating in-house laboratories to standardize the alkaloid extracts and produce drug compounds of higher purity than their European competitors. At the same time, state-sponsored scientists at the Government Cinchona Estate integrated laboratory sciences in the experimental and commercial practices of cinchona cultivation, thus paralleling the integration of laboratory research in the German pharmaceutical industry while connecting the standardization processes of the (German) pharmaceutical industry with the colonial practice of the cinchona planters. In this way, the Government Cinchona Estate grew to be a central node in a developing transoceanic agro-industrial network, which during the first decades of the twentieth century evolved into a Dutch transoceanic network. A central factor in the integration of a Dutch transoceanic cinchona-quinine network was the inclusion of the laboratory as a quality device, not only in the breeding and cultivation of cinchona bark, but also in the trade and production of quinine sulphate by the nascent Dutch pharmaceutical industry.

By the turn of the century, control over the entire product chain from raw material to finished product was pursued by the leading German pharmaceutical industry, which resulted in the establishment of the first international pharmaceutical cartel. In chapter two, I showed how an internal shift of power from the German to the Dutch transoceanic network took place during the first decade of the twentieth century within the international quinine cartel as a result of the successful positioning of the Dutch quinine industry. In chapter three, this shift of power was further consolidated, making the Cinchona Bureau the decision-making centre of a worldwide quinine cartel, and controlling the entire product chain from the agricultural production and supply of cinchona bark to the industrial production and supply of quinine sulphate and quinine medicines. In continuation, the Dutch-led international quinine cartel was able to capitalise on one of the first international public health campaigns, thereby promoting the sales of quinine at the expense of other community-based malaria control techniques and strategies.

Furthermore, the centralization of the Cinchona Bureau within this Dutch-controlled global quinine cartel during the 1920s and 1930s provides an early and telling example of the tensions between the global and local governance of an international pharmaceutical endeavour. As I showed in the third chapter, within the Dutch transoceanic enterprise, commercial interests prevailed over scientific interests, which resulted in the Cinchona Bureau's decreased interest in continuing the scientific work at the Cinchona Field Station in the Netherlands Indies as an essential driving force of the cinchona-quinine enterprise. The control of an essential medicine and the privileging of marketing over science resulted in a diminished incentive for scientific innovation and a curtailment of the free circulation of knowledge, thus inducing a state of ignorance for the sake of business interests in the Dutch-led international cartel. These tensions between the global and local governance, as shown in chapter four, were only strengthened as a result of the globalization of the cinchona and quinine product chain during the 1950s and are hence exemplary for the powerful, transformational forces of the globalization process in the post-war international pharmaceutical industry.

In addition, the monopolization of knowledge by the Cinchona Bureau regarding cinchona cultivation in the Netherlands Indies as well as the capitalization of the international malaria campaign shows that knowledge is closely connected to economic and political interests. As such, knowledge acted as a value-producing resource to foster the dominant position of the Dutch cinchona-

quinine enterprise on the worldwide quinine markets.[5] This thesis shows that to understand the development of the first international pharmaceutical cartel – in many ways the ur-example for later critiques of global oligopolistic collusions in the modern pharmaceutical industry – it is necessary to connect the hitherto various historical narratives of Dutch colonialism with the historical development of the pharmaceutical industry as an important actor in the development of modern health care, and also functioning in a hybrid medical market with both health and commercial interests.

Second, this thesis builds further on the historiographical concepts of colonial botany and green imperialism developed by historians like Londa Schiebinger, Claudia Swan and Richard Grove to analyse the multidirectional dynamics of interaction and the circulation of knowledge between science and commerce in the early modern period. In these interpretations, botany and the scientific search or quest, as Harold Cook has called it, for new (medical) knowledge was at the centre of European colonial expansion, and was a form of exchange that was also a product of the coevolution of science and commerce. The result was the creation of a global network of botanical gardens supported by scientists, naturalists, and adventurists in search of this green gold. From the mid-eighteenth century onward, botany developed into big business and involved industrial research as part of the emerging colonial empires and the Industrial Revolution. The overall scientific and commercial interest in colonial flora and fauna and the interaction among science, commerce, and colonialism intensified from the eighteenth to the nineteenth centuries, thus developing into both big business and a form of industrial research.[6] In this thesis, I have shown that the intensification of these interactions within the Dutch cinchona and quinine enterprise during the late nineteenth and the first half of the twentieth centuries, as part of the rise of modern science – especially the laboratory sciences – industrialization and the modern nation state, can be branded as colonial agro-industrialism.

In the first chapter, I showed how state-sponsored scientists at the Government Cinchona Estate integrated laboratory sciences in the experimental and commercial practices of cinchona cultivation and thus paralleling the

[5] According to Charles Tilly, people who control access to value-producing resources solve pressing organizational problems by means of categorical distinctions. Tilly 1998, 7-8.
[6] Schiebinger and Claudia Swan 2005, Grove 1995 and Cook, 2007.

integration of laboratory research as an integral part in standardizing the production processes in the German pharmaceutical industry. At the same time, through a specific scientist-planter network, the Government Cinchona Estate connected the standardization processes of the (German) pharmaceutical industry with the colonial practice of the cinchona planters. Henceforth, the Government Cinchona Estate became a central node in a developing transoceanic agro-industrial network of knowledge circulation. By the first decade of the twentieth century, as shown in the second chapter of this thesis, this network slowly evolved into a Dutch transoceanic network that was oriented towards a cinchona market in Amsterdam and an emerging Dutch quinine industry across the realms of the Dutch empire (the BKF in the Netherlands Indies and the NKF and ACF in the Netherlands). A central factor in the strengthening of this Dutch transoceanic cinchona-quinine network was the inclusion of the laboratory, as part of a global industrial laboratory revolution. The laboratory can be considered a quality device not only in the breeding and cultivation of cinchona bark, but also in the trade and production of quinine sulphate by the nascent Dutch pharmaceutical industry.

In addition, in the wake of the First World War, the Dutch quinine industrial network across the Dutch colonial empire was further strengthened between the Netherlands Indies-based BKF and the Netherlands-based NKF and ACF, which resulted in the creation of a transoceanic colonial-industrial joint venture (the Combinatie). A similar process of cooperation and exchange across the Dutch colonial empire and hence across formal borders of imperial and industrial formations was also visible in the consolidation of the Cinchona Bureau as the decision-making centre of the Dutch-led international quinine cartel. In this process, scientific and technological practices regarding product improvement were incorporated in both agricultural and industrial production sites across the Dutch colonial empire. Over time, the Dutch were thus able to forge a set of relations among resource exploitation, science, state-industry relations, and markets that were reinforcing and profitable, which gave them increasing economic and political power within the international quinine cartel.

The quinine case can be regarded as a demonstration project for studying the historical trajectories of other export commodity crops in the Netherlands Indies, which directly connected the agricultural production in the colony with the growing industrial demand for (standardized) raw materials in the motherland and Europe. So by applying colonial agro-industrialism as a 'successor' to colonial botany and green imperialism, this thesis not only illustrates the forging of alliances

between science, industry and the (colonial) state, but it also shows that the connections between science, the (colonial) state and industry were closely related to mechanisms or strategies of exploitation and development by various actors and interests. By aligning the standardized production and exploitation opportunities of colonial cinchona cultivation with the industrial development of the quinine industry in the motherland, the Dutch cinchona-quinine enterprise was finally capable of reaching a dominant position in both the cinchona and quinine world production and distribution. The exchange of (scientific) knowledge was crucial in the creation and maintenance of this colonial agro-industrial enterprise.

The establishment of these networks of power and control shows the historical continuities with similar forms of exploitation and expansion in the early modern period. In addition and despite the differences in nature and scale, the manipulative politics of science and governance shown in the cinchona-quinine case are exemplary for how the international pharmaceutical industry in the post-war period continued to orchestrate its activities towards the pharmaceuticalization of public health.

Thus, by connecting the historical narratives of Dutch colonial history with the historical narratives of science and technology and the development of the Dutch nation state during the early twentieth century, we can better understand how these colonial and imperial objectives of agro-industrial exploitability and profitability of commodity export crops were closely connected with the industrial objectives of creating a profitable and exploitable industry in the motherland. The historical trajectories of cinchona and quinine therefore not only show the colonial history of "our largest medicinal cultivation" as Mathieu Kerbosch has called it, but also show that the interaction, cooperation and the exchange of knowledge between science, commerce, industry and the (colonial) state is a continues historical process in which the search for (scientific) knowledge, wealth and power are closely connected.[7]

[7] Mathieu Kerbosch to Willem Sieger Jr., 1945. Kerbosch collection, no. 103, KITLV, Leiden University.

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Samenvatting

Koloniaal Agro-Industrialisme. Wetenschap, Industrie en de Staat in het Gouden Nederlandse Alkaloïde Tijdperk, 1850-1950

Dit proefschrift gaat over wat ik het Gouden Nederlandse Alkaloïde Tijdperk (1850-1950) noem. Drie kennisclaims staan centraal. In de eerste plaats laat het proefschrift zien hoe het laboratorium een centrale rol krijgt in de industriële en commerciële selectie en analyse van hoogwaardige (farmaceutische) grondstoffen en eindproducten in Europa én Azië. Hiermee wordt het historische proces van globalisering van de laboratoriumrevolutie zichtbaar gemaakt. In de tweede plaats maakt dit onderzoek inzichtelijk hoe de controle binnen het eerste internationale farmaceutische (kinine) kartel verschuift van de Duitse farmaceutische industrie naar de Nederlandse kinine-industrie in het interbellum. Ten derde wordt een belangrijke overgang van koloniaal agro-industrialisme naar agro-industrialisme in de periode 1940-1960 beschreven.

Het doel van dit proefschrift is om de opkomst van Nederland als leidende farmaceutische producent en distributeur van alkaloïden en specifiek de Nederlandse dominantie binnen het internationale kininekartel in de eerste helft van de twintigste eeuw te duiden. Ik volg hierbij de historische ontwikkeling van de productie en distributie van het koortswerend middel de kinaboom (*Cinchona officinalis Lin.*) en haar meest krachtige en therapeutisch toegepaste alkaloïde, het antimalaria geneesmiddel kinine in het Nederlands koloniale rijk. De introductie en acclimatisatie van de kinaboom in Nederlands-Indië en vervolgens de opkomst van een commerciële kinacultuur en de Nederlandse kinine-industrie binnen de contouren van het Nederlandse koloniale rijk aan het begin van de twintigste eeuw was een dynamisch proces van wisselwerking tussen de domeinen wetenschap, industrie en de staat. Dit historische proces is door Toine Pieters en mijzelf geconceptualiseerd als koloniaal agro-industrialisme. Om deze historische ontwikkeling te begrijpen verbindt dit proefschrift wetenschappelijk-farmaceutische geschiedenis met koloniale en industriële geschiedenis ('connected histories'). Op deze manier biedt het meer inzicht in de manier waarop wetenschappelijke en technische ontwikkelingen van invloed zijn geweest op de ontwikkeling van Nederland als een moderne, industriële staat en de rol van koloniale (zaken-) netwerken binnen de context van het Nederlandse koloniale rijk.

In het eerste hoofdstuk beschrijf ik hoe de dynamische wisselwerking tussen wetenschappers in dienst van de koloniale staat, ontwikkelingen in de farmaceutische industrie in Europa (voornamelijk Duitsland) en koloniaal bestuurlijke doelen uiteindelijk resulteerde in twee verschillende kinaculturen in de kolonie van Nederlands-Indië en de Britse koloniën van Brits-India en Ceylon (Sri Lanka). Sterk gedreven door de koloniale ambities van een Wingewest, ontwikkelde zich in Nederlands-Indië een hoogwaardige en commerciële kinacultuur, waarin de Gouvernements Kinaonderneming (een van de eerste autonome koloniale wetenschappelijk centra voor (commerciële) plantveredeling) tijdens het laatste kwart van de negentiende eeuw uitgroeide tot het centrum van een koloniaal netwerk van wetenschappers, planters en staatsfunctionarissen. Centraal binnen dit netwerk was de nadruk op de constante (wetenschappelijke) verbetering en standaardisatie van de kwaliteit van de kinabast door middel van het laboratorium als instrument voor kwaliteitscontrole. Deze benadering liep parallel aan de ontwikkeling in de Duitse farmaceutische industrie, waar het laboratorium een steeds centralere rol kreeg toebedeeld in de ontwikkeling en productie van hoogwaardige kwaliteitsgeneesmiddelen (zoals kinine) tijdens het laatste kwart van de negentiende eeuw. De vergelijking met het Britse koloniale imperium en haar kinaondernemingen dringt zich op. Bij de ontwikkeling van de Britse kinacultuur lag de bestuurlijke nadruk op zoveel mogelijk en zo goedkoop mogelijk antimalaria geneesmiddelen te ontwikkelen voor (intern) gebruik in het Britse rijk. Hierdoor kwam de wetenschappelijke en financiële nadruk te liggen op de ontwikkeling en productie van een goedkoper alternatief voor kinine (een combinatie van kinine en andere alkaloïden uit de kinabast) in plaats van de ontwikkeling van een hoogwaardige kinaboom voor de export naar de farmaceutische industrie.

In het tweede hoofdstuk staat centraal hoe tussen ongeveer 1880 en 1920 een Nederlands koloniaal netwerk van kinaproducenten en kinine-industriëlen het internationale kininekartel ging domineren en daarmee controle kreeg over de wereldwijde productie en distributie van kinine, het halffabricaat kininesulfaat en de grondstof kinabast. Sinds de jaren zeventig van de negentiende domineerde de Duitse farmaceutische industrie de internationale handel in kina, kininesulfaat en kinine en was deze leidend in de oprichting van het internationale kininekartel in 1894. In dit hoofdstuk beschrijf ik hoe een interne machtsverschuiving plaatsvond in het kininekartel in het voordeel van het Nederlandse kina- en kininenetwerk. Drie sterk met elkaar verbonden factoren worden hierbij onderscheiden. In de eerste plaats werd de productie van de kinabast in Nederlands-Indië gekoppeld aan de productie van het halffabricaat kininesulfaat en het uiteindelijke eindproduct

kinine door de farmaceutische industrie door de integratie van het laboratorium in het proces van standaardisering van de selectie, cultivatie en kwaliteitscontrole van de kinabast productie. In de tweede plaats ging de voorgaande ontwikkeling samen met de evolutie van een transoceanisch netwerk van kinaproducenten en -handelaren, kinine-industriëlen, (koloniale) wetenschappers en staatsfunctionarissen binnen de context van het Nederlandse koloniale rijk, dat een cruciale controle had over de kinabast voorraden in Nederlands-Indië. Ten derde ontstond met het uitbreken van de Eerste Wereldoorlog een economisch isolement van de Duitse industrie, waardoor de Duitse kinine-industrie haar controle over de productie- en distributieketen verloor.

Het derde hoofdstuk toont hoe vis-à-vis de verschuivende machtsverhoudingen binnen het internationale kininekartel een Nederlands kina- en kinineconsortium, bestaande uit kinaproducenten en kinine-industriëlen, zich ontwikkelt rond het Kinabureau. Tijdens het interbellum verstevigt en consolideert het Nederlandse consortium haar dominantie over de internationale kina- en kininemarkten en zien we hoe het door Nederland gedomineerde Kinabureau het besluitvormingscentrum wordt van het internationale kininekartel. Belangrijk hierbij is enerzijds de intensivering van de interne samenwerking via de oprichting van overkoepelende organisaties zoals de Kina Producenten Vereeniging en de Nederlandsche Chemie Combinatie. Anderzijds claimt het Nederlandse consortium de toegang tot de grondstof, de kinabast in Nederlands-Indië, en beperkt daarmee de Duitse en Zwitserse invloed. Zo laat ik via het voorbeeld van de Zwitserse farmaceut F. Hoffmann-La Roche zien hoe zij, uiteindelijk tevergeefs, in de jaren twintig een eigen netwerk van kinabast producenten probeerden op te bouwen in Nederlands-Indië om daarmee de Nederlandse dominantie te omzeilen. Tegelijkertijd beschrijf ik in dit hoofdstuk hoe het Nederlands gedomineerde internationale kartel via het Kinabureau niet alleen de wereldmarkten voor kina en kinine controleerde, maar ook in staat was te profiteren van de door de Volkenbond georganiseerde internationale campagne tegen malaria om de verkoop van kinine te promoten. Een speciaal marketingbureau, het Bureau ter Bevordering van het Kininegebruik, was met dit doel opgericht binnen het Kinabureau in 1923.

Aan alles komt een einde, zo luidt het adagium, en zo ook aan de Nederlandse dominantie van de kinaproductie en -distributie en de Nederlandse controle over het internationale kininekartel. In het laatste hoofdstuk laat ik zien hoe in de jaren vijftig en begin jaren zestig van de vorige eeuw de Nederlandse controle van het kartel onder druk kwam te staan en uiteindelijk tot een einde

kwam als gevolg van de globalisering van de internationale markten (opkomst van alternatieve kina producerende landen zoals de Congo in Afrika) en de economische dekolonisatie van Indonesië (met een abrupt einde op 'Zwarte Sinterklaas,' 5 december 1957). Het laatste hoofdstuk kan beschouwd worden als het sluitstuk van een historische ontwikkeling van ruim een eeuw waarin een dynamisch proces van wisselwerking en kennisuitwisseling tussen wetenschap, industrie en de (koloniale) staat resulteerde in de Nederlandse dominantie van een internationaal kartel dat de wereldwijde kina en kininemarkten controleerde. Dit resulteerde in een transformatie van het koloniaal agro-industrieel systeem naar een agro-industrieel systeem.

In 1930 stelde de vermaarde directeur van de Gouvernements Kinaonderneming, de farmaceut Mathieu Kerbosch, dat de Nederlandse dominantie over de internationale kininemarkten een natuurlijke uitkomst was gecreëerd door de wetenschap en in stand gehouden door de volharding van de planter. In dit proefschrift toon ik aan dat deze 'wetenschappelijke volharding' het resultaat was van decennia hard werken in het laboratorium, op het veld en in de bestuurskamer en daarmee de aanzet vormde voor het samengaan van commercieel winstbejag, wetenschappelijke kennis en agro-industriële productie binnen het Nederlandse koloniale rijk. Een dynamisch proces van kennisuitwisseling, innovatie en economische samenwerking lag dan ook aan de basis van een transoceanisch netwerk van kinaplanters en -handelaren, kinine-industriëlen en wetenschappers in dienst van de staat. Dit transoceanische netwerk was in staat om internationale dominantie te verwerven over de productie en distributie van de grondstof kinabast om vervolgens het internationale kininekartel te domineren en daarmee de internationale kininemarkten te controleren.

Dit proefschrift laat zien dat door het verbinden van de Nederlandse koloniale geschiedenis met de wetenschap- en technologiegeschiedenis we beter kunnen begrijpen hoe koloniale doelstellingen rond het winstgevend maken van agro-industriële export gewassen nauw verbonden zijn met industriële doelstellingen in het creëren van een winstgevende industrie in het moederland. De historische ontwikkeling van kina en kinine kenschetst daarom niet alleen de koloniale geschiedenis van "onze grootste medische cultuur," zoals Kerbosch deze genoemd heeft, maar laat ook zien dat de wisselwerking, samenwerking en kennisuitwisseling tussen wetenschap, industrie en de (koloniale) staat een continu historisch proces is waarin de zoektocht naar (wetenschappelijke) kennis, rijkdom en macht nauw verbonden zijn.

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Curriculum Vitae

Arjo Roersch van der Hoogte was born in Cusco, Peru on 2 February 1983. Between 1995 and 2000, he attended the Erasmus College in Zoetermeer. In 2006, he obtained his bachelor in history at the Vrije Universiteit (VU) and in 2008 his master in history at the Universiteit van Amsterdam (UvA). Between 2008 and 2010, Arjo worked as junior researcher under the supervision of Toine Pieters at the Vrije Universiteit and the Descarets Centre for the History and Philosophy of Sciences and the Humanities. His research concerned a thorough literature study regarding the history of drugs in Latin America and a pilot-study of pharmaceutical advertisements during the period 1900-1940 in the leading Dutch Medical Journal *Nederlands Tijdschrift voor Geneeskunde*. In addition, in 2009 and 2010, he was granted two travel grants to visit research institutes in Germany, Great Britain and Spain from the European Science Foundation program "Standard Drugs and Drug Standards. A Comparative historical study of pharmaceuticals in the 20th century." In January 2011, Arjo started his PhD research at the Utrecht University and during this period he published five international peer-reviewed articles. Furthermore, he organized and lectured on the history of pharmacy and the history of addiction. Since January of 2015, Arjo is responsible for the project '25 years Synthon' (1991-2016), researching and writing the company history of the Dutch pharmaceutical company Synthon.

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