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Science, industry and the colonial state: a shift from a German- to a Dutch-controlled cinchona and quinine cartel (1880–1920)

Arjo Roersch van der Hoogte* and Toine Pieters

This study shows how control over delicately balanced supply chains from raw material to the final product shifted from one national industry to another. By 1920, Dutch cinchona producers and quinine manufacturers dominated 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). Twenty years earlier, however, this cartel had been controlled by the German pharmaceutical industry. How can we understand the shift of power in the world's first pharmaceutical cartel? We argue that the internal shift of *power* was largely the result of the following three factors: a global industrial laboratory revolution; the vertical integration 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.

Keywords: cinchona, quinine, Netherlands Indies, colonial agro-industrialism, laboratory science and technology, pharmaceutical industry

Introduction

By 1920, Dutch cinchona producers and quinine manufacturers dominated the international cartel that controlled the worldwide production and distribution of quinine (an anti-malarial), quinine sulphate (a semi-finished product) and cinchona (the raw material). Twenty years earlier, however, this cartel had been controlled by the German pharmaceutical industry. How can we understand the shift of power in the world's first pharmaceutical cartel? We will 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 vertical integration 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.

Our study of the historical trajectories of cinchona and quinine during the early twentieth century can be understood in the wider historiographies of early twentieth century science and technology and the role of colonial (business) networks within the Dutch Empire. In recent years, substantial work has been published on how scientific and technological developments influenced the development of the Netherlands as a modern, high tech industrial state. These studies illustrate the interaction between government, industry and science in the Netherlands during the late nineteenth century and first half of the twentieth century.¹ In a colonial context, considerable scholarly work has been dedicated to the

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application of science and technology in the development of the sugarcane industry in the former Dutch colony of the Netherlands Indies (currently, Indonesia) and the role of science and technology in the development of the Netherlands Indies as a colonial state.² In regard to Dutch imperialism, scholars have argued that business interests dominated the expansion of the Dutch Empire (especially in the Netherlands Indies).³ They have shown how colonial business interest 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 connecting the colony more strongly with the motherland.⁴

These studies, however, tell us surprisingly little about these same interactions across the Dutch colonial empire and how colonial agricultural production sites contributed to the industrialization of the Netherlands and vice versa. Thus, this study 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. In doing so, we can understand how Dutch efforts to achieve a dominant position in quinine production, distribution and sales over the German pharmaceutical industry was played out by a colonial state marshalling not only state resources, but also resources from its colony. The internal power shift from German to Dutch control over the world's first pharmaceutical cartel is hence a story about European politics and their relationship to state building and the exploitation of colonial resources.⁵

Although the focus of this study is on the European actors in this transnational state-industry project, a brief characterization of relationships between the Dutch and the native population of the Netherlands Indies must be included to explore how the Dutch exploitation of local resources was shaped by these relationships. Since the time of the Dutch East India Company, the Netherlands Indies was 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 sought to modify the coercive state monopoly over agriculture in the colonies. This entailed foremost that private entrepreneurs (through the so-called 1870 Agrarian Law) were given a central role in the plantation economy and export of tropical commodities like sugar, coffee, tea and cinchona bark.⁶ In addition, the law introduced a system of (low) wages for the native population working on these new plantations. In this way, the profit-making colony, according to the historian Cees Fasseur, was better adapted to the demands and the spirit of the time.⁷

Furthermore, an important contribution of this study 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 relative limited global demand for quinine which was merely used as an anti-malarial at the time.⁸ Thus, the balance between supply of the raw material and the demand of the final product was quite delicate. Overproduction and hence price erosion were always lurking at the back. In order to control the delicately balanced product chain the German quinine manufacturers formed the first global pharmaceutical cartel in the

1890s.⁹ At the same time, in response to growing consumer demands for pure and trustworthy medicines the German pharmaceutical industry would focus attention on purification and standardization throughout the product chain. Laboratory research became an integral part in standardizing the industrial production process and enhancing the quality standards of the final and semi-finished products but also of the raw material.¹⁰ We 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.

The first part of the article will describe how a cinchona network was established around the laboratory-controlled production of a high-quality raw material in the Dutch Empire between roughly 1880 and 1910. The second part will discuss how two Dutch-controlled quinine factories became strong competitors of the German-led cartel (within an international quinine production network), opened up and subsequently gained leadership of the cartel. The third part will focus on how the colonial state's involvement and interventions resulted in combining the cinchona and quinine networks. In the final part, we will discuss how the First World War proved to be a strong factor (catalyst) for integrating the various networks and allowed the Dutch to establish control over the international cinchona and quinine cartel.

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

The single most important aspect in the emergence of a cinchona network in the Dutch empire was the production of a high-quality and standardized raw material – cinchona bark. In 1852, the first cinchona tree was introduced in the Netherlands Indies, initiating a process of acclimatization and experimentation under the guidance of the scientific directors (university-trained pharmacists) of the Government Cinchona Estate (GCE). By the early 1870s, the scientific directors Karel Wessel van Gorkum and Bernelot Moens laid the scientific-technological basis for the Netherlands Indies' cinchona cultivation by introducing laboratory sciences and experimental field techniques. In this way, they developed a high-quality and standardized cinchona species, *Cinchona Ledgeriana*, which contained four times more alkaloid quinine than the species that were commercially available at the time. The laboratory-conditioned *Ledgeriana* species matched the pharmaceutical industry's high-quality demands for raw materials and this became the backbone of the Dutch commercial cinchona cultivation for the following decades.¹¹

With the introduction of this high-quality species by the GCE, private planters showed a growing interest in cinchona cultivation. By 1890, over one hundred planters in the Netherlands Indies were producing cinchona bark for the foremost European pharmaceutical companies. This growth also stimulated cinchona trade within the Dutch empire and by the late nineteenth century, several trading houses were involved in commerce 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 within the Dutch empire.¹² However, the formation of this network required hard work.

By the late nineteenth century, the cinchona network was divided into two sub-networks: one primarily based in the Netherlands Indies and 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.¹³ An analysis was necessary to determine the amount of quinine-sulphate chemical, thus making these analyses central to the production and trade in 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.¹⁴

We 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 standardization of chemical analysis and botanical research as critical for success. In this process, the GCE as a scientific and coordinating centre for cinchona breeding, cultivation and quality control played a crucial role.

Building a scientist-planter network in the Netherlands Indies (ca. 1880–1900)

During the last quarter of the nineteenth century, the Netherlands Indies' agricultural export economy was reformed in accordance with new ideas of liberal trade as the colony became accessible to European private capital.¹⁵ For cinchona, private initiatives flourished. By 1890, after the introduction and promotion of *Ledgeriana* cultivation, more than 120 cinchona plantations existed in the Netherlands Indies resulting in an exponential growth in cinchona production. This rapid growth, however, resulted in a surplus of cinchona bark on the international markets and by the late 1880s and 1890s prices for cinchona bark began to decline rapidly. In British India and Ceylon (Sri Lanka) private cinchona planters (who had been the largest producers in the world until the early 1890s) began to abandon cinchona cultivation in favour of other crops. In the Netherlands Indies, however, cinchona cultivation remained viable and subsequently came to dominate the world supply of cinchona bark by the turn of the twentieth century (see Figure 1). According to Goss, ironically, the low-price crisis affecting cinchona planters worldwide had allowed the Dutch to dominate the worldwide supply.¹⁶ However, this observation begs the question of how and why this dramatic market shift occurred.

While the Dutch objective for cinchona bark had always been to make the colony profitable, the British had aimed to secure abundant cinchona bark for the production of cheap febrifuges (fever-reducing drugs, based on a mix of alkaloids extracted from the cinchona bark) for the military, which was seen as instrumental to strengthening their imperial colonial rule. As we have argued in a previous publication, an important reason why the British cinchona planters abandoned cinchona cultivation by the late 1880s and 1890s was the lack of an autonomous scientific centre in India that could support the cinchona industry in Ceylon both scientifically and financially.¹⁷ As declining market prices did not undermine the British efforts to secure an inexpensive febrifuge, there was no need for the British colonial authorities to create an autonomous scientific centre in India to support private cinchona cultivation. Without government incentive and support in response to the declining prices, the profit-seeking Indian private planters just switched from cinchona to other crops with the potential for more profit. On the contrary, in the Netherlands Indies, the colonial government supported the establishment of an agricultural field station with a quality control laboratory on the premises of the GCE to serve the interests of both the government and the planters through the constant improvement

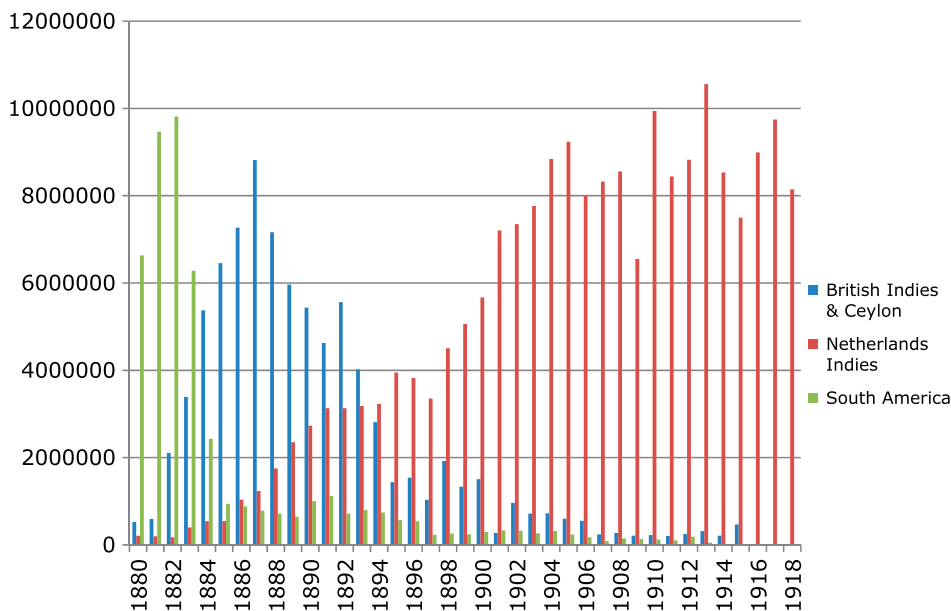


Figure 1. Cinchona bark exported in kilograms, 1880–1918. (Dethloff, *Chinin*.)

and standardization of the quality of the cinchona barks to match the demands of the European cinchona markets.

Serving the interests of the planters in the Netherlands Indies required substantial work on the part of the GCE. Like their British counterparts, the Dutch planters also suffered from the low prices and did not trust the government's role as a 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 GCE's cultivation activities as unfair competition.¹⁸ Some planters saw no problem 'if the government cinchona estate would disappear,' however, most favoured the role of the GCE as an experimental field station (*proefstation*), where 'the best ways of soil development, harvesting, etc., should be followed and where all experiments necessary should be conducted.'¹⁹ Despite the planters' criticism and the colonial government's willingness to transform the GCE entirely into an agricultural field station, the GCE remained the largest individual cinchona plantation in the colony, producing approximately one tenth of cinchona bark in the Netherlands Indies exported during the late nineteenth century.²⁰ Despite the significant presence of the government as producer, the GCE directors Richard van Romunde (1882–1892) and Pieter van Leersum (1892–1914) decided to build on the scientific-technological basis of laboratory analysis and field experimentation that had been introduced by directors van Gorkum and Moens in the late 1860s and 1870s. They gradually began to strengthen the role of the GCE as an agricultural field station to directly support the private planters' cultivation activities.²¹ In doing so, they partially acknowledged the planters' criticism while simultaneously positioning the GCE as the scientific and coordinating centre of the Netherlands Indies' cinchona cultivation.

In line with the opinion of other colonial state experts, such as the director of the Botanical Garden at Buitenzorg, Melchior Treub, who supported the idea of the GCE as a scientific centre (field station), the GCE scientific directors stressed the importance of scientific and technological guidance by the colonial government.²² In 1890, for example, the annual report of the GCE stated that its main goal was to increase the barks' quality in order to meet the 'mission' of the Government and fulfil the wishes of the private industry.²³ In other words, the GCE's main task was to scientifically increase the barks' quality and hence create a profitable export commodity. 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.²⁴ 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.²⁵

The GCE also became a coordinating centre when, by the 1890s, director Pieter van Leersum took an active stance as spokesman for all of the Netherlands Indies' cinchona cultivation.²⁶ The formation of a European quinine cartel in 1894 (see next part) 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 quinine industry and provided technical information, several planters began to experiment with quinine sulphate extraction on their plantations.²⁷ In 1895, Van Leersum became the spokesman of a group of 20 planters who sought support from the colonial government for the construction of a quinine sulphate factory in the city of Bandung; as a result, the cooperative *Bandoengsche Kininefabriek* (BKF) was established in 1896. 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.²⁸

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 private Netherlands Trading Association in 1869. From 1876 onwards, the first small consignments of privately produced cinchona were exported and it was only after 1882 that private exports begin to surpass government exports.²⁹ 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 Netherlands Indies were sold in London where most of the European quinine manufacturers bought their raw material.³⁰

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 1886.³¹ Other trading companies such as the Netherlands Trading Association followed suit. 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.³² 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.³³

Cinchona traders and brokers, empowered by the laboratory's involvement, advertised a high-quality cinchona product to their customers, especially 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 also 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 million kilograms of cinchona bark were traded on the Amsterdam market making this the largest market for cinchona bark in the world.³⁴

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 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 joint cinchona ventures.³⁵ In 1894, the global cinchona network was strengthened with the founding of the Amsterdam based *Vereeniging ter Bevordering van de Belangen der Kinacultuur* (Association for the Advancement of the Interests of the Cinchona Cultivation, better known as Kinavera), whose members were mostly traders, colonial brokers and chemists (Table 1).³⁶ Whereas the Cinchona Establishment became an obligatory

Table 1. The main Dutch group of members of the *Vereeniging ter Bevordering van de Belangen der Kinacultuur* (Kinavera), 1894.^a

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

^aVereeniging, *Notulen Tweede Algemeene Vergadering dd. 12 september 1894*, KIT collection, Leiden University.

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

We have shown how the Netherlands Indies' cinchona cultivation developed in relation to the European pharmaceutical industry's demands for a high-quality and standardized raw material for quinine medicine production. This emphasis on high-quality quinine medicines was the result of a competitive battle between producers of patent medicines and a pharmaceutical industry that had begun to emphasize 'ethical' drugs as a standard in the marketplace. 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.³⁷ In response to the rapid growth of this patent-medicine industry (so-called nostrum-makers) and unrestrained marketing, the European and American medical professionals severely criticized such medicines as threats to society and public health and a threat to 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, using the best raw materials.³⁸ The German pharmaceutical industry, which by this time had grown into the most important and largest industry of its kind in Europe, was keen to create in-house laboratories in order to produce drug compounds with a higher purity than their European rivals.³⁹

Since quinine was isolated in 1820, the international scientific community, including physicians, pharmacists and chemists, had been tackling the question of what the therapeutic qualities of quinine were for an anti-febrifuge in comparison to other so-called side-alkaloids of the cinchona tree. During the 1860s and 1870s, some European scientists, stimulated by the success of the British India cinchona program, regarded these side-alkaloids to be as effective as quinine. However, from the mid-nineteenth century on, medical professionals preferred to prescribe pure quinine drug preparations probably due to the large variability in the composition and therapeutic effects of the side-alkaloids compounds in comparison to quinine.⁴⁰ The German pharmaceutical industry took the doctors' preferences to heart and 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.⁴¹ Chemists like G. Kerner of the quinine manufacturer Vereinigte Chininfabriken Zimmer & Co. and L. Schäfer of the pharmaceutical company C.F. Boehringer & Söhne constantly refined the extraction process of removing quinine sulphate from the bark.⁴² 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 2) 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.⁴³ 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 were only available primarily to wealthy patients.⁴⁴ 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 undermined prices.⁴⁵ 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 quinine, in contrast, to sugar, for example. 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 in the 1880s disrupted this delicate balance between supply and demand, resulting in the rapid price decline. Thus, the German quinine manufacturers formed the first pharmaceutical cartel in an effort to restore, and hence control, this delicately balanced product chain.

Until the 1880s, a dozen companies were involved in the production and distribution of 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.⁴⁶ During the 1880s, several talks were held between these three companies and their interests gradually merged, 'opening the door for the creation of the quinine cartel.'⁴⁷ To avoid further declining prices for both quinine sulphate and quinine medicines and 'to bring order on the quinine market,' the three German companies opted for price stability and in 1893, they made a private price agreement and set fixed sales prices for quinine.⁴⁸ In that same year, the Amsterdamsche Chininefabriek (ACF) joined the private agreement and one year later, in 1894, the

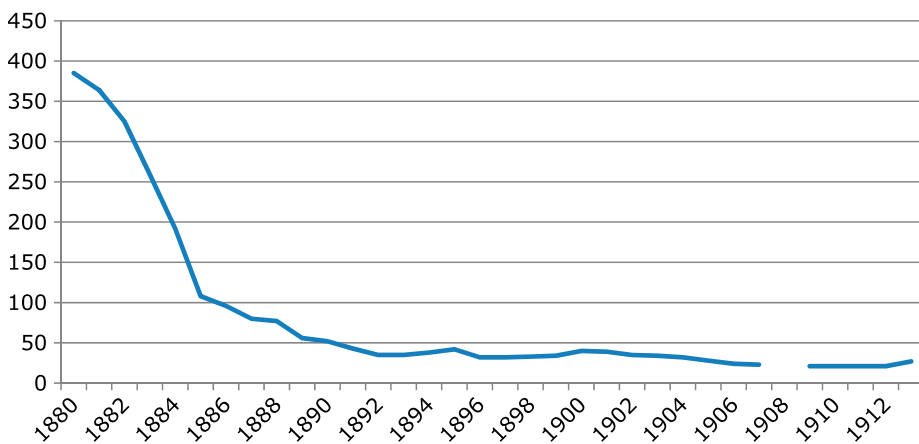


Figure 2. Price for a kilogram of quinine sulphate in German Reichmarks, 1880–1913. (Dethloff, *Chinin*.)

British quinine manufacturer Howards and Sons Ltd and the French company Société du Traitement des Quinquinas also joined the price agreement, thus creating the first international quinine cartel (Table 2). The cartel would be administrated by the Deutsche Gold- und Silber-Scheideanstalt (or Dagusa for short), which had owned the quinine factory Auerbach, but then sold it to Boehringer in 1891 in exchange for increased and improved cooperation within the German quinine industry.⁴⁹ Under Dagusa's administration, prices slowly increased from 17.50 guilders a kilogram in 1893 to 22,50 guilders a kilogram in 1894.⁵⁰ 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.⁵¹

The objective of this first pharmaceutical cartel, which expanded in 1907 to four (official) members and two unofficial new members (Table 3), 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.⁵² This meant that another important objective for the cartel was to achieve control over the production and distribution of cinchona bark in response to the monopolization of cinchona production and trade by the Dutch network of planters, traders and brokers. By adapting high-quality standards for the raw material and chemical analysis to determine the quality of the cinchona bark, the quinine manufacturers (and foremost the German companies) were in a position to strongly influence the outcomes of cinchona auctions and product prices. Henceforth, the cartel was able to control the cinchona bark auctions held every month at the Cinchona Establishment in Amsterdam.⁵³

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 overproduction, and disruption of the delicate balance, was the result of deliberate speculation by the quinine industry and the use of sub-standard chemical analyses to determine prices.⁵⁴ 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 laboratory.⁵⁵ By blindly accepting quinine-sulphate analyses that indicated a lower quality of cinchona barks and justifiable 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 the cinchona planters.⁵⁶ The Amsterdam traders and brokers,

Table 2. The first pharmaceutical cartel: the quinine cartel of 1894.^a

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

^a*Geschiedenis der N.V.*, 17; Buchler, *Dreihundert Jahre Buchler*, 106 and Ziegler, *Die Familie Jobst*, 133–4.

Table 3. The quinine cartel in 1907.^a

Company	Location
C.F. Boehringer & Söhne	Mannheim, Germany
Verenigde 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	Maarsse, The Netherlands
Unofficial members:	
Powers & Weightman Rosengarten & Co.	Philadelphia, United States of America
McKesson & Robbins	Brooklyn, United States of America

^a*Geschiedenis der N.V.*, 27.

however, blamed the low prices on overproduction and the irresponsible way the planters in the Netherlands Indies exported their product without regard to market surpluses.⁵⁷ In addition, Dutch chemists questioned the quality of the chemical analysis conducted by the GCE laboratory.⁵⁸ As a consequence, 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 eventually diminished distrust and gradually made way for cooperation, thus facilitating 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 as the founding of the BKF, the establishment of the Batavian market was a response to the formation of the quinine cartel in 1894. As mentioned earlier, the cartel enforced control over the cinchona auctions in Amsterdam and hence cinchona prices. The objective of creating the Batavian 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-controlled Amsterdam market. Although, the Batavian 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.⁵⁹ The BKF produced quinine sulphate and after the GCE laboratory had analysed the quality, it was traded and sold by Tiedeman & Van Kerchem.⁶⁰ 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.⁶¹

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.⁶² 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 increased stability in 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 accustomed to conducting so-called cultivation analysis (*cultuur-analyse*) for research on how the quinine sulphate content developed in regard to soil, climate and other cultivation conditions. During the 1890s, Pieter van Leersum began to conduct so-called trade analyses (*handels-analyse*) to determine the quinine sulphate content of the commercial cinchona barks.⁶³ As mentioned, these trade analyses were considered to be of lower quality compared to analyses conducted in European laboratories. In 1901, to decide if 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 trade analysis should also 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.'⁶⁴

Thus, the GCE was granted the right to continue cinchona trade analyses and address the issue of its comparatively lesser 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.'⁶⁵ In the following years, more planters began to send their commercial samples to the GCE laboratory before sending their cinchona bark to Europe.⁶⁶ The planters had to pay the GCE a small fee for each chemical analysis. This was symbolic of the planters' growing commitment to the GCE, and more importantly this action positioned the GCE laboratory as a central institution in the emerging cinchona production and trade network across the Dutch empire. The GCE's 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.

Cooperation within the emerging cinchona network was stimulated by reforms in the colonial administration. In 1905, the various Dutch government plantation estates and the botanical garden at Buitenzorg had all been centralized under the control the government's Department of Agriculture. The result was the colonial government's growing involvement in the private plantation economy.⁶⁷ In 1909, the agriculturist H.J. Lovink (1866–1938) was appointed director of the Department and in 1910, under his energetic directorship 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 was able to achieve formal cooperation among the majority of the cinchona planters, in that sense that an understanding was reached for a singular policy in regard to cinchona production and exportation.⁶⁸ Lovink

believed that ‘only a healthy cooperation’ would result in a satisfactory solution for the growing price crisis and also help to avoid the destruction of the colonial government’s capital invested in the cinchona cultivation since the mid-nineteenth century. Therefore, he urged 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 they had a decade earlier throughout the Dutch empire. This concentration also resulted in a changing relationship with the quinine manufacturers. Since the cinchona network in the Dutch empire now held a worldwide monopoly on cinchona production and trade, the quinine manufacturers were obliged to buy most of their raw material at one of ten annual auctions held at the auction house, ‘Brakke Grond,’ in the centre of Amsterdam.⁶⁹ In other words, the manufacturers became dependent on the Dutch cinchona production and trading network for their raw material.

The German-led quinine cartel, established in 1894, sought to challenge the Dutch monopolization 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 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 by 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. We will show how the two Dutch-controlled factories had an advantage of easy access to raw material and also managed to adopt the Germans’ chemical knowledge and production technology.

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 the Dutch cinchona and quinine producers and traders. As mentioned earlier, a group of cinchona planters drafted a plan for a ‘planter’s quinine factory’ during the mid-1890s, to ensure better prices for cinchona bark from the Netherlands Indies. In the years prior to the establishment of the BKF, some cinchona planters in the Netherlands Indies had 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.⁷⁰ However, their geographic location was a challenge for receiving chemicals and material for the extraction process (cinchona plantations were located in the hills with an average altitude of 1500 meters), addressing the humidity of the climate, and complying with the highly standardized demands for quality, which made these activities quite costly.⁷¹ 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 that the factory was 'largely owned by planters themselves.'⁷² 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.⁷³ In the early years, however, the BKF struggled to deliver a high-quality quinine sulphate product due to lack of competent chemists. In early 1898, a sample of the BKF 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.'⁷⁴ To ensure the viability of the BKF factory, it became of high importance to improve the quinine sulphate product.

In 1900, the BKF management appointed a new technical director, the young chemist Arent Roelf van Linge (1870–1934). This young and 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 to stimulate the growth and technical knowledge of Dutch industry.⁷⁵ 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 practice his chemical-technical knowledge.⁷⁶

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 (Figure 5).⁷⁷ However, after two years, Van Linge left the BKF and returned to Europe.⁷⁸ In 1903, the young pharmacist S. van Velzen Camphuis was appointed as the new technical director of the BKF. 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 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 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.⁷⁹

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.⁸⁰ BKF production contributed about 10% of this total: an average of 40–50.000 kilograms a year (Figure 3). Two-thirds of their production was sold at public auctions in Batavia by the trading company Tiedeman

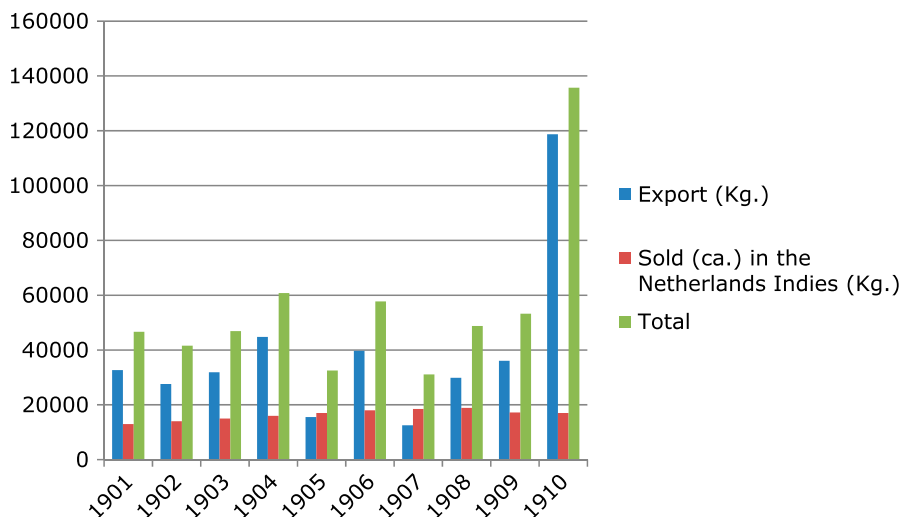


Figure 3. Production of quinine sulphate in kilograms by the Bandoengsche Kininefabriek, 1901–1910. (Dienst der belastingen in Nederlandsch-Indie, *Kina en Kinine*, Bijlage 4.)

& Van Kerchem and shipped to various parts of the world. According to the American, Seely, ‘a great deal of it coming to America.’⁸¹ 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 the BKF to improve its technical capabilities and production capacity.

The BKF was positioned amongst the leading quinine factories in the world by 1910 with a production level of more than 120,000 kg of quinine sulphate (Figure 3). They accomplished this 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 1909.⁸² BKF, though, was not the only Dutch firm in the market.

The Nederlandsche Kininefabriek, 1902–1910

In 1881, the first quinine factory was established in the Netherlands, the ACF. From the start, the ACF depended on German technological expertise to produce a high-quality and standardized quinine sulphate product. A German chemist who had worked in German industry was appointed technical director of the ACF and by the mid-1880s, Boehringer & Söhne was asked to take over the production process. The ACF remained under the technical leadership of Boehringer & Söhne until 1905. In 1907, a majority of ACF shares were bought by the Deutsche Gold-und Silber-Scheideanstalt and thus the ACF became part of the German quinine cartel.⁸³

The ACF’s position was challenged by the NKF, which had been founded in 1903–1904 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 quinine cartel. Although the NKF

was not situated near the cinchona plantations, we 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.⁸⁴ 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. 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.⁸⁵ 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.⁸⁶ 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.⁸⁷

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.⁸⁸ 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 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.⁸⁹

Within a decade, the NKF became one of the leading quinine manufacturers in the world, positioning itself as a successful competitor of the leading German companies within the 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.

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, we will show how the establishment of the American connection in the transoceanic network and the gradual shift in control over the product chain from raw material to final product provided the conditions for the shift in the internal balance of power in the newly established cinchona and 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 network. 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).⁹⁰ In 1879, the US 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% of the global quinine production.⁹¹ 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 products in this country.'⁹² 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 Batavian quinine sulphate market, it 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.⁹³ 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 1899–1900.⁹⁴ 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.⁹⁵

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 Greeff & Co., a British company. Greeff & Co. opened 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 was acquired by Merck & Co. by 1927) 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.⁹⁶ 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 quinine cartel.⁹⁷

The American connection thus provided the BKF and NKF with an important market for their product and offered them the opportunity to be positioned as important internal competitors to the German-controlled quinine cartel. 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.⁹⁸ Moreover, direct access to the American market helped to foster the vertical integration of a transoceanic network of cinchona producers, quinine manufacturers, (colonial) scientists and state officials across the Dutch Empire.⁹⁹

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 1905.¹⁰⁰ In combination with the low quinine sulphate price offered by the BKF 'outsider', prices for quinine sulphate and quinine medicines also dropped after 1905 and exports of quinine medicines by the three German companies declined from 182.300 kilograms in 1907 to 171.500 kilograms in 1909.¹⁰¹ The emergence of the BKF and NKF and the cinchona planters and traders' growing control 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, the director of the Netherlands Indies Department of Agriculture, took the lead in bringing together the cinchona producers and quinine manufacturers to try to restore the balance in the product chain. During the years 1911 and 1912, several talks took place between representatives of the Dutch cinchona network (planters and traders) and the 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.¹⁰²

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. This meant they withheld the product from the market in order to pressure the German companies to rethink their position by delaying the sales of cinchona bark.¹⁰³ 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.¹⁰⁴ 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 quota and maintenance of its direct overseas markets with 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.¹⁰⁵

The Cinchona Agreement and Cinchona Bureau, 1913: an international cinchona and quinine cartel

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 just as they had with the talks leading to the creation of the cartel. This was illustrated by the location of these final talks, the location of Bureau in Amsterdam, 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.¹⁰⁶

On 12 June 1913, these men signed the Cinchona Agreement and representing 95% of all cinchona producers and seven quinine manufacturers (see Figure 4). Among these seven manufacturers, none were from the United States, the United Kingdom 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.¹⁰⁷ The Agreement entailed two central principles. The first was that the quinine cartel members were obliged to buy 515.000 kilograms of quinine sulphate cinchona bark a year for five years, and only from member producers. This meant the cinchona producers were obliged to reduce their production by approximately 10% to meet this quota. 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.¹⁰⁸ 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 4).

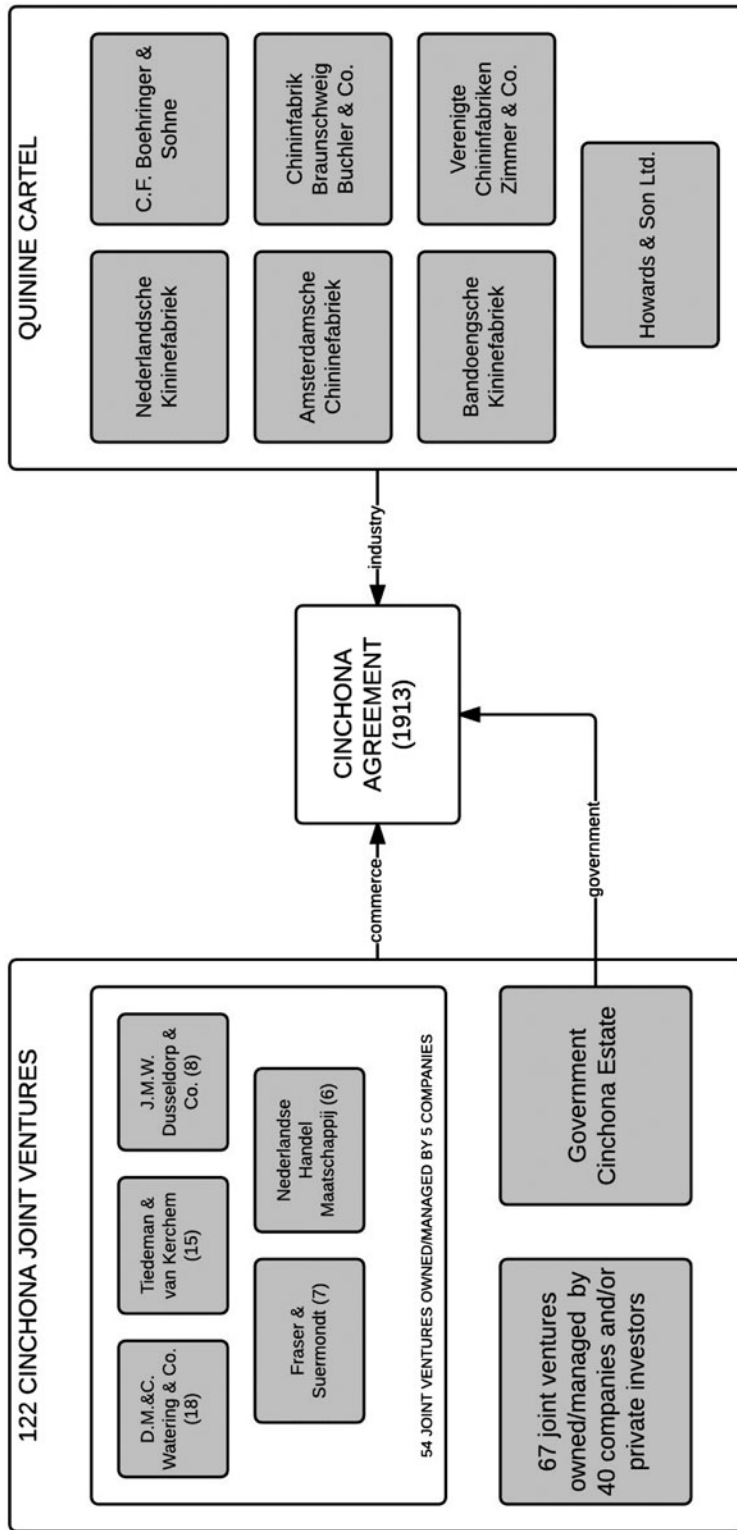


Figure 4. The Cinchona Agreement and the various parties involved. (In comparison to the 1907 quinine cartel, fewer quinine manufacturers joined the new cinchona and quinine cartel, notably the four French manufacturers. However, it remains unclear why this occurred.)

Table 4. The first board of management of the Cinchona Bureau, 1913.^a

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 ^b	Lawyer and political broker	Chairman

^aKina-bureau to NHM, 1 November 1913. Item 9007, Archief NHM, NA, The Hague. List of importers, auction 14 July 1910, No. 75, No. 666 Archief Makelaardij Westerman & Co, Stadsarchief Amsterdam.

^bRamaer 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, *De Nederlandse koloniale lobby*, 102–8.

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

The First World War: further strengthening the dominant 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 was to initiate a process of protectionism in which national governments emphasised self-reliance, stimulating stronger forms of cooperation between enterprise and government and businesses.¹⁰⁹ In the Netherlands, private and public projects were initiated to stimulate the Dutch economy and industry.¹¹⁰ 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 1918.¹¹¹ For 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% 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, 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 situation, adding that 'as soon as these extraordinary circumstances, which justify this reduction, are over the

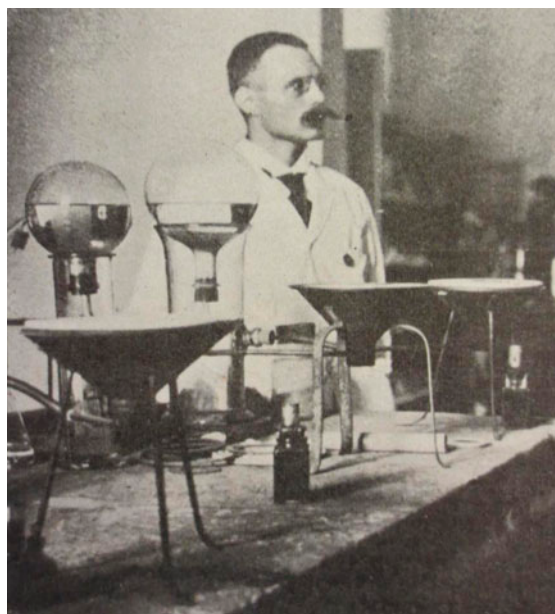


Figure 5. Dr. A.R. van Linge as technical director of the BKF, approximately 1899–1900.
Source: Seely, "Quinine."

normal purchase will take its course again.'¹¹² 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 raw materials and their foreign export markets. The British blockades to curtail German imports and exports 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.¹¹³ 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, thus making the Dutch the largest producers of quinine sulphate.¹¹⁴ 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.¹¹⁵

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 quinine sulphate and by late 1917 they faced shortages of cinchona bark.¹¹⁶ 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 beyond 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.¹¹⁷ This agreement created such a solid base of trust between the companies that 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.'¹¹⁸

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 vertical integration of the two networks into one 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 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.¹¹⁹ This ensured large profits for both the cinchona producers and the Dutch quinine manufacturers during the remaining years of the war and the first post-war years.¹²⁰ By 1920, the three Dutch quinine 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.¹²¹

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

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.'¹²² 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 18 September 1917, representatives of the Dutch 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.¹²³ Isolated as a result of the war, the German manufacturers saw no option other than to place control over the essential raw material into the hands of the Dutch.

After several talks in 1917, Dutch producers and manufacturers signed the Second Cinchona Agreement in 1918. In comparison with the first agreement, two changes were crucial for formalising Dutch control and dominance over the worldwide production and distribution of cinchona and quinine.¹²⁴ 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 the sales price for quinine sulphate. The second

Table 5. The international cinchona and quinine cartel 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

important change was that the agreement was signed between the cinchona producers and only the three Dutch quinine manufacturers. The new Cinchona Bureau board thus became a 100% Dutch-controlled agency that controlled almost 90% of the worldwide production and distribution of cinchona and hence quinine sulphate.¹²⁵ 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 5).¹²⁶

Conclusion

The history of cinchona and quinine sulphate production and distribution in the Dutch empire shows how control and power over delicately balanced supply chains from raw material to the final product shifted from one nation to another. By the turn of the twentieth century, the German pharmaceutical industry took the lead in the cinchona–quinine supply chain and to safeguard their position, they established the first pharmaceutical cartel. Thus, the three major German companies were able to control the quinine sulphate and quinine medicine prices. In addition, with their extensive industrial experience, superior technical expertise and lead in the industrial laboratory revolution, 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 the cinchona bark and the quinine sulphate, the Dutch colonial agro-industry was able to break open the German-controlled cartel and gradually shift the internal balance of power in its favour. Three interlinking factors in this power shift can be distinguished.

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 European pharmaceutical industry through the introduction of laboratory analysis in cinchona bark breeding, cultivation and quality control. The integration of the laboratory for quality control in both the production and trade of cinchona bark, resulted in a process of standardization that reified 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 monopoly with a focus on quality standards and high yields that matched the demands of the German pharmaceutical industry.

The second interlinking factor was the vertical integration of a transoceanic network of cinchona producers, quinine manufacturers, (colonial) scientists and state officials across the Dutch empire and their crucial control over the cinchona bark stocks. Despite their monopoly on 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 they 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 German control over the international cinchona and quinine markets. Both manufacturers built a strong base in scientific and organizational approaches to the extraction and sales of quinine sulphate and gained access to the raw material through their direct contacts with the cinchona network. Furthermore, through the establishment of the American transpacific connection, the Dutch manufacturers had direct access to the world's largest national medical market for 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 power within 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 vertical integration of the transoceanic network and created the circumstances for the formalisation of complete control over the cinchona and quinine cartel by the Dutch cinchona and quinine industry by the signing of the second Cinchona Agreement and the formation of a totally Dutch-controlled Cinchona Bureau by 1918.

The historical trajectories of cinchona and quinine sulphate production and distribution in the Dutch empire show how the inclusion of the laboratory, as part of a global industrial laboratory revolution, was crucial in connecting the colonial cinchona bark cultivation with a high-quality and standardized pharmaceutical production of quinine sulphate and quinine medicines. Hence, two distinct networks of interest were integrated into one transoceanic colonial agro-industrial network of (colonial) scientists, traders, industrialists and state officials. This historical study illustrates how the formation of this colonial agro-industrial network was pivotal in shifting the balance of control and power over cinchona bark and the production of quinine at the turn of the twentieth century and how the Dutch exploited profitable resources, scientific advances, state-industry relations, and markets that, in the end, provided them with economic and political power.¹²⁷

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Notes

1. See for a thorough analysis Schot et al., *Technology*.
2. Liedelmeijer, *Van suikermolen tot grootbedrijf*; Maat, "Technology and the Colonial Past"; Knight, *Commodities and Colonialism*; Goss, *The Floracrats*; Moon, *Technology and Ethical Idealism* and van der Schoor, "Zuivere en toegepaste wetenschap."
3. See for a review of this historiography Raben, "New Dutch Imperial History?"
4. Kuitenbrouwer and Schijf, "Dutch Colonial Business Elite"; Taselaar, *De Nederlandse koloniale lobby*; Lindblad, "The Late Colonial State" and van Zanden, "Colonial State Formation."
5. See, amongst others, Frankema and Buelens, *Colonial Exploitation*.
6. van Zanden, "Colonial State Formation," 170.
7. Fasseur, "Purse or Principle," 35. See also, van der Zwaag, *Verloren Tropische Zaken*. van Zanden, "Colonial State Formation," 170; Goss, *Floracrats*, chapter 4 and Moon, *Technology and Ethical Idealism*, 16.
8. Goss, "Building," 9.
9. 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, *Die Deutsche 'Pharmazeutische Interessengemeinschaft'*.
10. Cunningham and Williams, *Laboratory Revolution in Medicine*.
11. This development is described and analysed in depth in Roersch van der Hoogte and Pieters, "Colonial Agro-Industrialism."
12. Andrew Goss has argued that with the formation of the *Vereeniging ter Bevordering van de Belangen der Kina-cultuur* (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, "Building," 12.
13. Kerbosch, "'s Lands Kina-onderneming," 437.
14. Vledder et al., "Particuliere laboratoria in Nederland." On the existence of various kinds of laboratories, see van Rooij, "Knowledge, Money and Data."
15. Jonker and Sluiterman, *Thuis op de wereldmarkt*, 177–80; van der Zwaag, *Verloren Tropische Zaken*, 27–32 and van Zanden, "Colonial State Formation," 170–3.
16. Goss, "Building," 12.
17. This development is described and analysed in depth in Roersch van der Hoogte and Pieters, "Colonial Agro-Industrialism."
18. 'Schrijven particuliere ondernemers aan Gouverneur-Generaal, 4 augustus 1893,' Verbaal no. 19, 6 december 1894, file 4884 Archief Ministerie van Koloniën 1851–1900, NA, The Hague. See also Roersch van der Hoogte and Pieters, "Colonial Agro-Industrialism," 20.
19. 'De Gouvernements Kinatuinen op Java' and 'De Gouvernements Kina-cultuur.' 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, "Building," 12.
20. van Gorkum, *Kina*, 122.
21. Roersch van der Hoogte and Pieters, "Colonial Agro-Industrialism," 20.
22. *Verslag omtrent der Gouvernements Kina-onderneming in de Preanger-Regentschappen over het jaar 1892*. Colonial collection (KIT), Leiden University; "De Gouvernements kina-onderneming" and Kerbosch, "'s Lands Kina-onderneming."
23. *Verslag omtrent der Gouvernements Kina-onderneming in de Preanger-Regentschappen over het jaar 1890*. Colonial collection (KIT), Leiden University.
24. Between 1872 and 1903, the GCE's laboratory was situated in the city of Bandung. Kerbosch, "'s Lands Kina-onderneming," 429. See also Roersch van der Hoogte and Pieters, "Colonial Agro-Industrialism."
25. The GCE as such was part of a broader development in which science was seen as instrumental for agricultural development in the Netherlands Indies. Harro Maat, *Science cultivating practice*, 69. In regard to the field station, see van der Schoor, "Zuivere en toegepaste wetenschap," 43–5.
26. Andrew Goss has pinpointed the role of the GCE directors as 'protector'. Goss, "Building," 12.

27. *Jaarverslagen Gouvernements Kina-onderneming in de Preanger-regentschappen over het jaar 1890–1899*. Colonial collection (KIT), Leiden University. See for a more in-depth account of Van Leersum's work on trying to build a quinine factory in the Netherlands Indies, Goss, "Building," 12–3.
28. *Jaarverslagen Gouvernements Kina-onderneming in de Preanger-regentschappen over het jaar 1890–1910*. Colonial collection (KIT), Leiden University 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, National Archive, The Hague.
29. van der Wielen, "De kinahandel te Amsterdam."
30. van der Wielen, "De kinahandel te Amsterdam" and *Geschiedenis der N.V.*, 1.
31. Wichers Hoet, *Van Heekeren & Co.*, 170–1.
32. van der Wielen, "De kinahandel te Amsterdam" and Groothoff, *De Kinacultuur*, 108–9.
33. van der Wielen, "De kinahandel te Amsterdam" and van Gorkum, *Kina*, 126–8. See also Vledder, Houwaart and Homburg, "Particuliere laboratoria in Nederland."
34. van der Wielen, "De kinahandel te Amsterdam." See also, Ziegler, *Die Familie Jobst*, 133.
35. *Handboek voor cultuur- en handelsondernemingen*, 1888.
36. Vereeniging, *Notulen Tweede Algemeene Vergadering dd. 12 september 1894*, KIT collection, Leiden University.
37. Huisman, "Patiëntenbeelden," 217 and Wimmer, "Die Pharmazeutische Industrie."
38. Roersch van der Hoogte and Pieters, "Javanese coca," 102–3. For the rise of the pharmaceutical industry, see amongst others Liebenau et al., *Pill Peddlers*; Liebenau, *Medical Science and Swann, Academic Scientists*.
39. Burhop, "Pharmaceutical Research" and Wimmer, "Wir haben fast immer was Neues".
40. Kerbosch, "Cinchona Culture in Java," 321; Algera-van der Schaaf, *Dr. Johan Eliza de Vrij*, 154; Meshnick and Dobson, "History of Antimalarial Drugs," 18 and Ziegler, *Die Familie Jobst*, 49–51. See for an historical overview of quinine in medical practice, Meshnick and Dobson, "History of Antimalarial Drugs" and Kaufman and Rúveda, "The Quest for Quinine."
41. Wimmer, "Wir haben fast immer was Neues".
42. Ziegler, *Die Familie Jobst*, chapter 6.
43. van Gorkum, *Kina*, 133; Ziegler, *Die Familie Jobst*, 130–1 and Webb, *Humanity's Burden*, 113.
44. Webb, *Humanity's Burden*, 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, "The use of quinine," 253.
45. Groothoff, *Kinacultuur*, 113.
46. Ziegler, *Die Familie Jobst*, 90–1.
47. Buchler, *Dreihundert Jahre Buchler*, 106.
48. 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, *Dreihundert Jahre Buchler*, 105.
49. Buchler, *Dreihundert Jahre Buchler*, 105–6.
50. *Geschiedenis der N.V.*, 17.
51. *Ibid.*, 133.
52. Burkert, *Die Deutsche 'Pharmazeutische Interessengemeinschaft'* and Ziegler, *Die Familie Jobst*, 133–4.
53. *Geschiedenis der N.V.*, 23 and Homan van der Heide, *Enige aantekeningen*.
54. van Gorkum, *Kina*, 130.
55. Maurenbrecher, "Kina en Kinine" and Maurenbrecher, "Statistiek van kinabast en kinine." See also Goss, "Building," 11.
56. Maurenbrecher, "Kina en Kinine."
57. Brusse, *Verslag der Kina-Markt* and Vereeniging, *Notulen Derde Algemeene Vergadering dd. 17 juni 1895*.
58. "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, National Archive, The Hague.

59. 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, *Van Heekeren & Co.*, 170.
60. *Verslag omtrent der Gouvernements Kina-onderneming in de Preanger-Regentschappen over het jaar 1900*. Colonial collection (KIT), Leiden University and N.V. Bandoengsche kininefabriek, *Verslag*, 1901–1905.
61. Seely, “Quinine.”
62. Cross, “Quinine Production and Marketing.”
63. *Jaarverslagen Gouvernements Kina-onderneming in de Preanger-regentschappen over het jaar 1892–1899*. Colonial collection (KIT), Leiden University.
64. “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, National Archive, The Hague.
65. *Jaarverslagen Gouvernements Kina-onderneming in de Preanger-regentschappen over het jaar 1903*. Colonial collection (KIT), Leiden University.
66. *Jaarverslagen Gouvernements Kina-onderneming in de Preanger-regentschappen over het jaar 1903–1911*. Colonial collection (KIT), Leiden University.
67. See amongst others Moon, *Technology and Ethical Idealism*; Goss, “Decent Colonialism?” and Goss, *The Floracrats*, chapters 3 and 4.
68. *Notulen der op 16 augustus 1910 in een der lokalen der handelsvereniging 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.
69. Homan van der Heide, *Enige aantekeningen* and Heuschen, “Maarssen.”
70. Citation of the planter A. Massink in a memo sent 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, NA, The Hague.
71. Homan van der Heide, *Enige aantekeningen*.
72. Seely, “Quinine.”
73. *Jaarverslag Bandoengsche Kininefabriek 1898*, KIT collection, Leiden University.
74. *Geschiedenis der N.V.*, 18.
75. Homburg et al., “Chemici,” 305. In regard to scientific research in industry and academia in the Netherlands, see Homburg, *Speuren op de tast*.
76. Kina-Bureau, “In Memoriam” and *Proceedings*, 20–4.
77. Seely, “Quinine” and Kina-Bureau, “In Memoriam.”
78. According to the annual report of the BKF Van Linge left the Netherlands Indies 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 Heekeren to modernize the factory, as reasons for Van Linge to leave. N.V. Bandoengsche kininefabriek, *Verslag 1902* and Heuschen, “Maarssen.”
79. N.V. Bandoengsche kininefabriek, *Verslag 1905* and N.V. Bandoengsche kininefabriek, *Verslag 1906*.
80. Groothoff, *Kinacultuur*, 113.
81. Seely, “Quinine.”
82. Ziegler, *Die Familie Jobst*, 144.
83. *Geschiedenis der N.V.*, 1–16.
84. Heuschen, “Maarssen” and *Geschiedenis der N.V.*
85. For the American medical market and pharmaceutical industry, see Liebenau, *Medical Science*.
86. Homan van der Heide, *Enige aantekeningen* and Heuschen, “Maarssen,” 39.
87. Homan van der Heide, *Enige aantekeningen* and Heuschen, “Maarssen,” 39.
88. Homan van der Heide, *Enige aantekeningen* and Heuschen, “Maarssen,” 39.
89. *Geschiedenis der N.V.*, 28.
90. McCabe, *History*, 393–4; “The Quinine Manufacturers” and Spillane, *Cocaine*, 56–7.
91. Webb, *Humanity’s Burden*, 113–4.
92. “The Quinine Manufacturers.”
93. Seely, “Quinine.”

94. 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.
95. Jackson, *Built for the Ages*.
96. Homan van der Heide, *Enige aantekeningen*; Heuschen, "Maarssen" and "Merck and Power-Weightman-Rosengarten Firms Consolidated."
97. *Geschiedenis der N.V.*, 27.
98. Spillane, *Cocaine*, 57.
99. In regard to a historical analysis on vertical integration within an interfirm network setting, see amongst others Fruin, "Business Groups."
100. Cross, "Quinine Production and Marketing."
101. Dethloff, *Chinin*; Cross, "Quinine production and marketing" and Ziegler, *Die Familie Jobst*, 134.
102. von Winning, *De Kina-crisis*; Buchler, *Dreihundert Jahre Buchler*, 110 and several documents in No. 12 of the Kerbosch collection, KITLV, Leiden University.
103. von Winning, *De Kina-crisis*.
104. Verbaal 17 maart 1913, no. 18, Item 1024, Archief Ministerie van Koloniën, Openbaar, 1900–1953, NA, The Hague. See also Goss, "Building the World's Supply of Quinine," 14–5.
105. 'Aanteekeningen boekje, no. 18' and 'Aanteekeningen boekje, no. 15, No. 12, Kerbosch collection, KITLV, Leiden and Buchler, *Dreihundert Jahre Buchler*, 110.
106. *Mededeelingen van het Kina-Bureau*, No. 17, VI (Nov. 1925), Colonial Collection (KIT), Leiden University.
107. The *Kina-overeenkomst 1913*, Item 9007, Archief NHM, NA, The Hague and M. Kerbosch, "Nota betreffende de Kina-situatie, behoorende bij het schrijven van den directeur der gouvernementen kina-onderneming dd. 13 januari 1927, No. 25 aan den directeur van Landbouw, Nijverheid en Handel te Buitenzorg", no. 98, Kerbosch-collection, KITLV, Leiden.
108. von Winning, *De Kina-crisis*. See also Goss, "Building," 15.
109. Sluyterman, *Dutch Enterprises*, 75–88.
110. Schot and Rip, "Inventing," 22.
111. Homburg, "De Eerste Wereldoorlog," 329. One of its founders was W. Sieger, the director of the ACF.
112. Cinchona Bureau to N.I. Kinavera, 27 oktober 1914. Item 9007, Archief NHM, NA, The Hague.
113. Kruizinga, "Economische Politiek," 51–9.
114. *Geschiedenis der N.V.*, 31–2. In regard to the British blockade and the Dutch trade in general, see Kruizinga, "Economische Politiek."
115. Homan van der Heide, *Enige aantekeningen*.
116. The British blockade resulted in similar circumstances for the other products imported from the Netherlands Indies. See Kruizinga, "Economische Politiek."
117. N.V. Bandoengsche kininefabriek, *Verslag 1917*.
118. N.V. Bandoengsche kininefabriek, *Verslag 1919* and *Geschiedenis der N.V.*, 32.
119. "Kinabast en Kinine," *Economische-Statistische Berichten*, 212–3.
120. *Geschiedenis der N.V.*, 31.
121. N.V. Bandoengsche kininefabriek, *Verslag 1919*; N.V. Bandoengsche kininefabriek, *Verslag 1920* and Ziegler, *Die Familie Jobst*, 136.
122. N.V. Bandoengsche kininefabriek, *Verslag 1919*.
123. 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, NA, The Hague.
124. *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, NA, The Hague.
125. The Cinchona Bureau would also be represented by a special delegation in the Netherlands Indies. "Kina-Overeenkomst", *Economische-Statistische Berichten*.

126. In theory, the old 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 quinine cartel was re-established under the leadership of the Dutch quinine industry and strongly imbedded in the structure of the Cinchona Bureau. Kerbosch, “Cinchona Culture in Java,” 339.
127. How the Dutch implemented and consolidated this economic and political power during the subsequent 1920s and 1930s is described and analysed in depth in Roersch van der Hoogte and Pieters, “Quinine, malaria, and the Cinchona Bureau.”

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