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One hundred years at the Botanic Garden TU Delft

# The green laboratory

*Trudy van der Wees*



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# Foreword



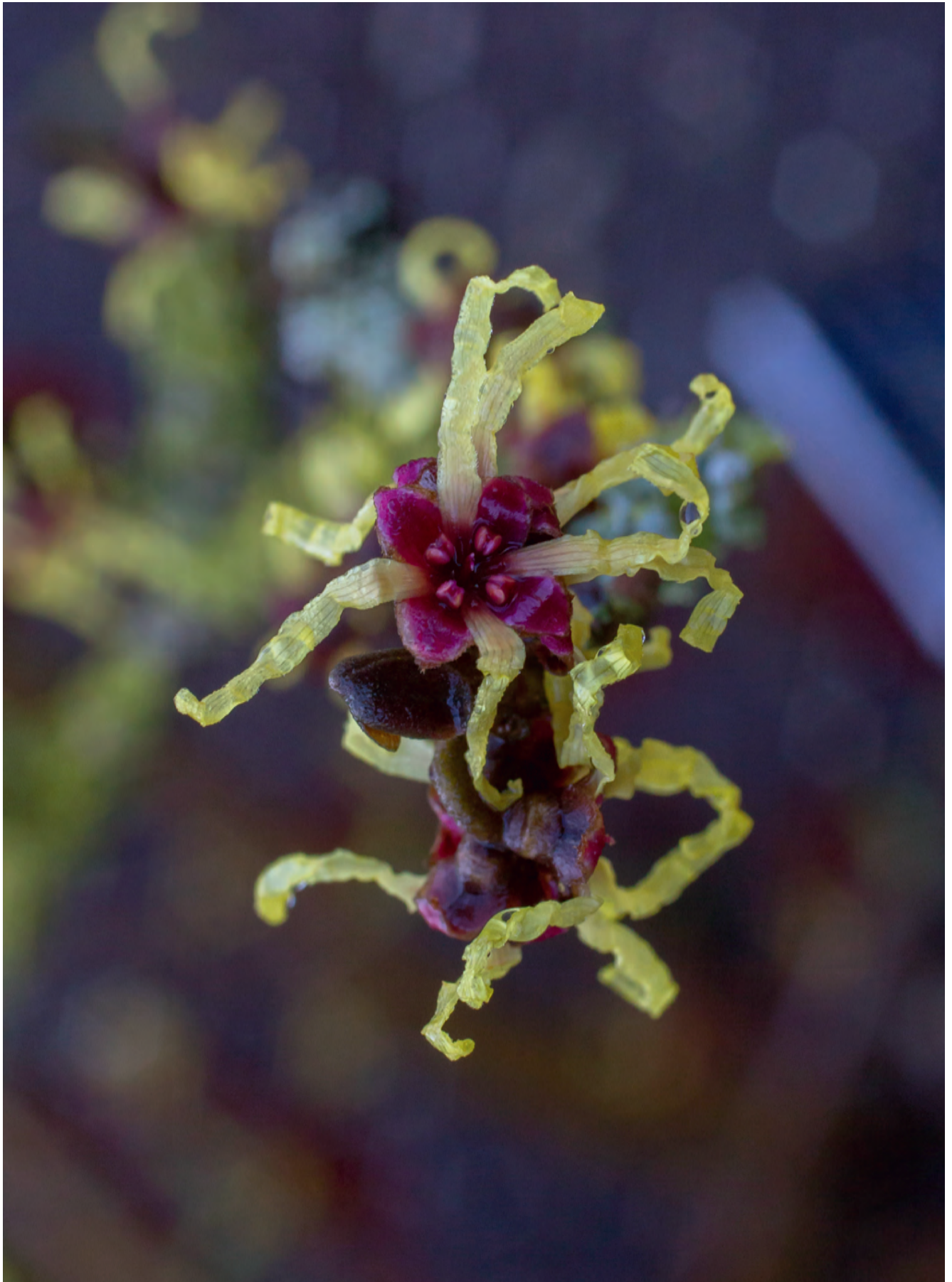
My first day at TU Delft is still vivid in my memory. In 1983, having just taken up an appointment as professor of bioprocess technology, I found on my desk a card bearing the text: The Professor hereby grants admittance to the Botanic Garden. It was dated 193\_. The last digit was meant to be filled in by the person thus authorized. As the new professor, that authorization evidently fell to me, and some colleague (who would remain anonymous) perhaps felt it their duty to inform me. With a pre-printed, handwritten entry card, no less – something that sounds utterly foreign to us now in this age of iris scans, fingerprints and voice recognition. The Professor in question was, of course, Gerrit van Iterson, professor of microscopic anatomy. It was he who founded the Botanic Garden in 1917, staying at the helm until 1948 after navigating it safely through the 1930s.

I ended up working at the building at 67 Julianalaan for sixteen years. Back then it was still called the Biological Chemistry building, later to become the Kluyver Laboratory for Biotechnology. I have fond memories of the parties we so enjoyed organizing in the garden in those years, though at the same time it was becoming increasingly apparent that something needed to be done to restore the garden to its former glory. When in 1999 I was made dean of the faculty of Applied Sciences, which also put me in charge of the Botanic Garden as its director, I asked Pieter van Mourik to draw up a policy plan for the garden. We were able to free up resources to make it more appealing and accessible to the public as well as to appoint as the garden's new director the ever-enthusiastic Bob Ursem, who also took the initiative for this book. There was only one proviso: the garden would focus its energies on educational and public

activities, not on scientific research. Bob Ursem, however, had different ideas. Those ideas were discussed in a spirit of healthy debate and good harmony, and in the end we always gave him the scope he asked for. This was to ring in a new renaissance for the Botanic Garden.

Now, the Botanic Garden once more finds itself poised on the cusp of a new era. The fascinating history of its past one hundred years is set out in this beautiful book. But what does the future have in store? These days, robotics companies occupy the building at 67 Julianalaan. The campus, society and the whole world are changing at lightning speed. At the same time, the links between science and society, between the campus and the city, are growing more important than ever. The Botanic Garden, together with the adjacent Science Centre, can play a wonderful role in helping to forge those links. I envision the garden as a marvellous green bridge between the city and the campus. With its new entrance on Kanaalweg and exit on Mijnbouwstraat, we can create a path that guides visitors from the bustle of Delft to our increasingly verdant campus. In years to come, when I have laid down my duties as Rector Magnificus, I would love to be able to take a stroll there. Whether that day will come, only time will tell. What is certain is that the Botanic Garden – like nature itself – will continually evolve towards a new balance.

*Professor Karel Luyben*  
Rector Magnificus, TU Delft





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# Introduction

Delft is known worldwide as a City of Knowledge. This reputation it owes principally to the presence of Delft University of Technology (TU Delft), the Netherlands' largest technical academic institution, and more in particular to the extensive knowledge economy animated by the university's magnetic effect on knowledge-intensive companies and organizations. This development is by no means recent: more than a hundred years ago, the university's presence was already galvanizing the city into an innovative commercial and industrial hotspot. In the early twentieth century, cross-pollination between the then Polytechnic School, students, industry and the city led to the formation by Jacques van Marken of a conglomerate of factories under the name Delftse Nijverheid ('Delft Industry'). Van Marken's imperium would leave an indelible mark on the city of Delft. Thanks to Van Marken and to the Polytechnic, turn-of-the-century Delft ranked among the most industrialized cities in the Netherlands, where Delft-based engineers blazed trails for major industrial changes not only at home but also far afield.

The period spanning the end of the nineteenth century and the beginning of the twentieth was one of unbridled optimism and faith in a brighter future. Memories of the last war were fading, the

colonies guaranteed a permanent flow of income, the Industrial Revolution was in full swing and new machines, new materials and new natural resources were redefining science, industry and daily life. People believed wholeheartedly in the prosperity promised by technological progress and looked confidently to what the future would bring. Scientists were very well aware of their ability to help shape a better world, and freshly minted engineers eagerly set out in search of problems in need of solving. Fortunately for them, technological challenges abounded.

Two illustrious scientists whose vision would prove paramount in Delft's emergence as a City of Knowledge were the microbiologist and founding father of virology Professor Martinus Beijerinck (1851-1931) and Professor of microscopic anatomy Gerrit van Iterson (1878-1972). It was Van Iterson who came up with the idea to create a botanic garden at TU Delft, which he conceived as a 'Culture Garden of Technical Crops'. He was also one of the architects of an impressive number of knowledge institutes, among them the Netherlands Organisation for Applied Scientific Research (TNO) and certification institutes in and outside the Netherlands. He strongly believed that science should be used to solve the practical problems that faced society. These days, the transfer and commercialization of knowledge is accepted to be one of the core tasks of any university, but in Van Iterson's day collaboration between academia and industry was by no means matter-of-course –quite the reverse in fact. So, it was hardly surprising that his efforts met with some resistance. Over the course of its hundred-year history, the Botanic Garden that Van Iterson started a century ago has regularly had to fight for its very existence. Not every university administration was equally convinced of the added value of the 'scien-

*'May I show you my garden? It is sunny there, and the flowers are so lovely.'*

Prof. Martinus Beijerinck

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tific garden'. Yet Van Iterson's garden (along with its predecessors) was to play an instrumental role in the birth of biotechnology – the modern field of science that encompasses a wide range of processes to harness living organisms for human use – which today is one of the cornerstones of TU Delft and among Delft's unique selling points as a City of Knowledge. At present, the largest faculty at TU Delft is the faculty of Applied Sciences, which encompasses the Biotechnology department alongside the departments of Bionanoscience, Chemical Engineering, Imaging Physics, Quantum Nanoscience, and Radiation Science and Technology. Just as under Beijerinck and Van Iterson a century ago, research continues to focus on discovering cutting-edge solutions to practical problems facing society. In addition, the faculty has set up the Kluyver Centre for Genomics of Industrial Fermentation and Bio-based, Ecologically Balanced Sustainable Industrial Chemistry (BE-Basic) to support this work and the industry.

TU Delft, the DSM biotechnology group and the City of Delft have joined forces to further advance industrial biotechnology. One of the fruits of their efforts is Biotech Campus Delft, which accommodates the faculty of Applied Sciences as well as a business centre with high-tech lab facilities for small biotech companies. Companies based at this campus have the opportunity to work with and recruit from the many high-level knowledge institutes in and around Delft. Here, technological innovation is generating new profit models. At the DSM premises – former home of Van Marken's Yeast and Spirit Factory, where the young Beijerinck once conducted his research on yeasts – there is now an open campus for biotech enterprise, including a Bioprocess Pilot Facility where companies can test innovative biotechnology processes.

In Delft today, many hundreds of millions of euros are being invested in industrial biotech, a specialism that was still in its infancy a hundred years ago. Beijerinck, Van Iterson and Van Marken all had a major hand in putting modern-day Delft at the forefront of international biotech research and the translation of this research into innovative products. A hundred years on, we have come full circle, back to the main objective behind Gerrit van Iterson's creation of the Botanic Garden in 1917: to build a bridge that would connect science and industry.



*A brass memorial plaque of Professor Gerrit van Iterson, founder of scientific rubber research in the Netherlands, presented by members of the staff of the Rubber Foundation, 1940.*

These days, everything and everyone at TU Delft is grounded in the premise that technology should be deployed in collaboration with industry as a tool to solve the world's problems, from identifying and combating viruses that could wipe out entire harvests to finding methods to reduce particulate matter, and from growing crops under photosynthetic LED lighting to experimenting with natural wild plant species that can help to reinforce dykes in third-world countries. The Botanic Garden at TU Delft is active on all these fronts of innovation. Relatively inconspicuous, and at first glance perhaps not even terribly interesting, it is upon learning the story behind it that this garden comes to life. This anniversary publication tells that story: the fascinating account of a garden that no one much cared about, on a piece of land that no one wanted. It is a chronicle of keen scientists and ingenious engineers who were indefatigable in pursuing their ideals. Far ahead of their times, their contributions, in hindsight, were key stepping stones leading to Delft's worldwide reputation as an innovative knowledge industry hotspot. Then as now, the Botanic Garden at TU Delft acts as a wellspring for ground-breaking, cutting-edge innovations that spark off new companies and industries. Is this simply a continuation or progression of the past, or are we witnessing a rediscovery of everything that this botanic treasure trove has to offer modern science and technology?









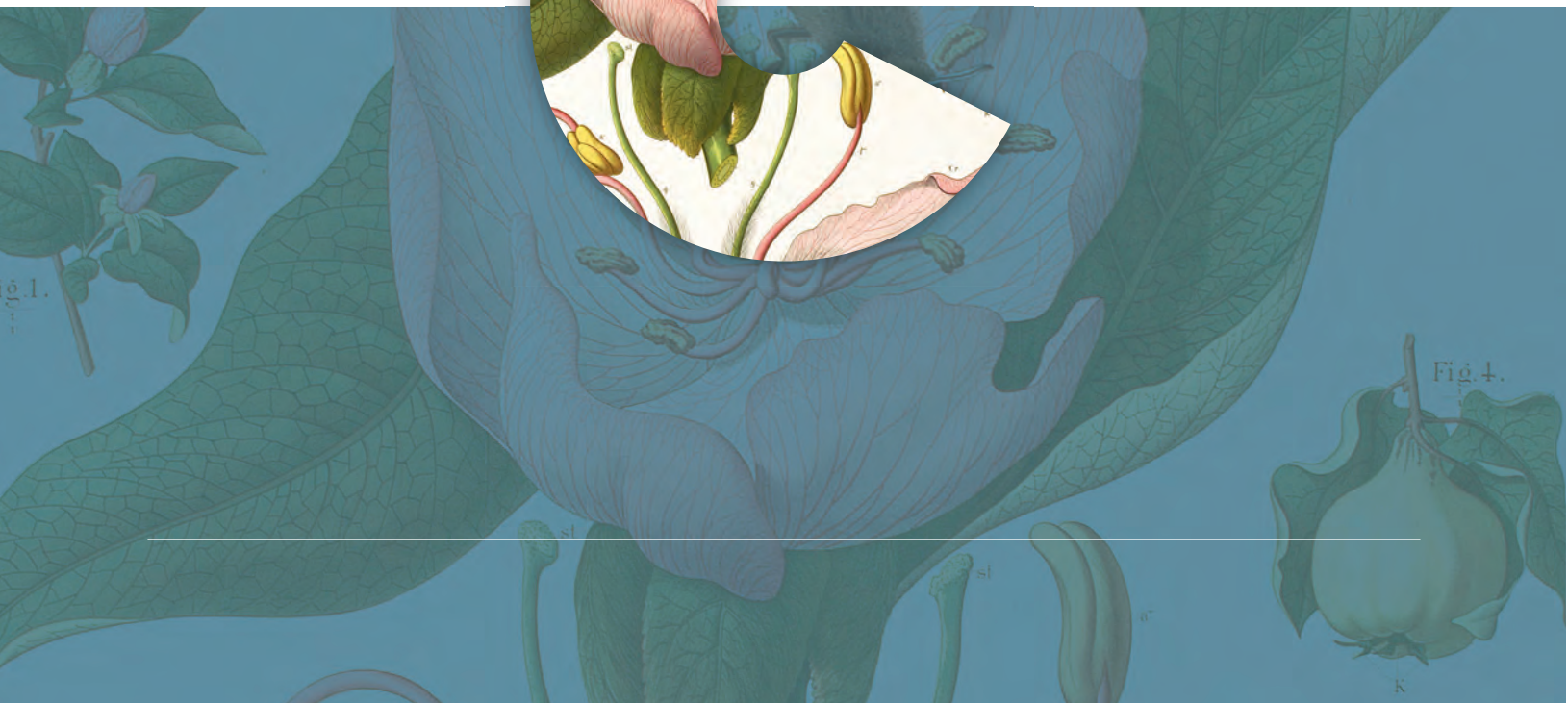


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Paving the way for a botanic garden

# A late bloomer

The Netherlands' first botanic garden in Leiden owes much to a botanist from Delft. But it was not until 1917 – with technical education firmly established in the city – that Delft got its own Culture Garden of Technical Crops.





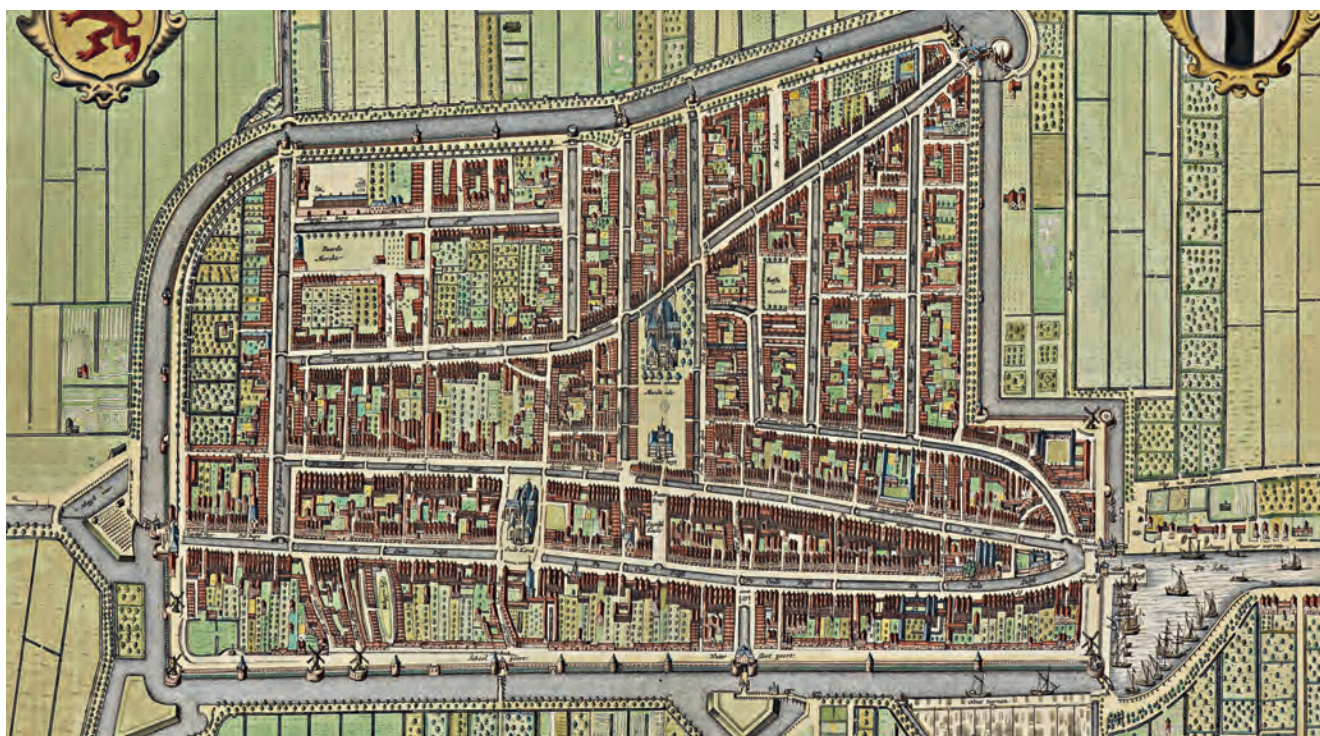
Tucked away in a busy residential neighbourhood, the Botanic Garden Delft University of Technology is a tranquil green oasis, a unique piece of nature amidst the bustle of urban life. What many people, even locals, do not know is that the garden also has a scientific purpose. In fact, university gardens have a long tradition of serving both societal and scientific interests. Back in the sixteenth and seventeenth centuries, plants and herbs played a vital role in everyday life. Craftsmen coloured fabric and leather using vegetal dyes made from plants such as madder, woad and safflower; painters used walnut and linseed oil as binding agents for pigments. More important, herbs were used as medicine, with as much as eighty per cent of all medicinal remedies made from plants. Laudanum, obtained from opium poppies, was effective against headaches, for instance. Hellebore and colocynth could be distilled to produce laxatives and purgatives. These and many other herbs were cultivated in botanic gardens. The earliest such a garden to be affiliated with a university was the Orto Botanico in

Pisa, begun in 1544, where plants were grown for medicinal uses and studied by physicians, apothecaries and students. In the decades that followed, botanic gardens were planted all across Europe, including in the Netherlands, where twenty-five survive to this day.

### Dirck Outgaertsz Cluyt

Not all botanic gardens trace their roots to a university, of course. Some owe their existence to wealthy patrons, whose arboreta can be a feast for the senses but lack any scientific character.

The Botanic Garden TU Delft is neither as imposing nor as old as the gardens of the universities of Amsterdam and Leiden, nor as picturesque and extensive as the Trompenburg arboretum in Rotterdam. Also, the garden is not to be compared to large arboreta and botanic gardens abroad, some of which have evolved to become veritable tourist attractions. Delft's Botanic Garden is what you might call a late bloomer. A mere hundred years old, it is positively youthful compared to



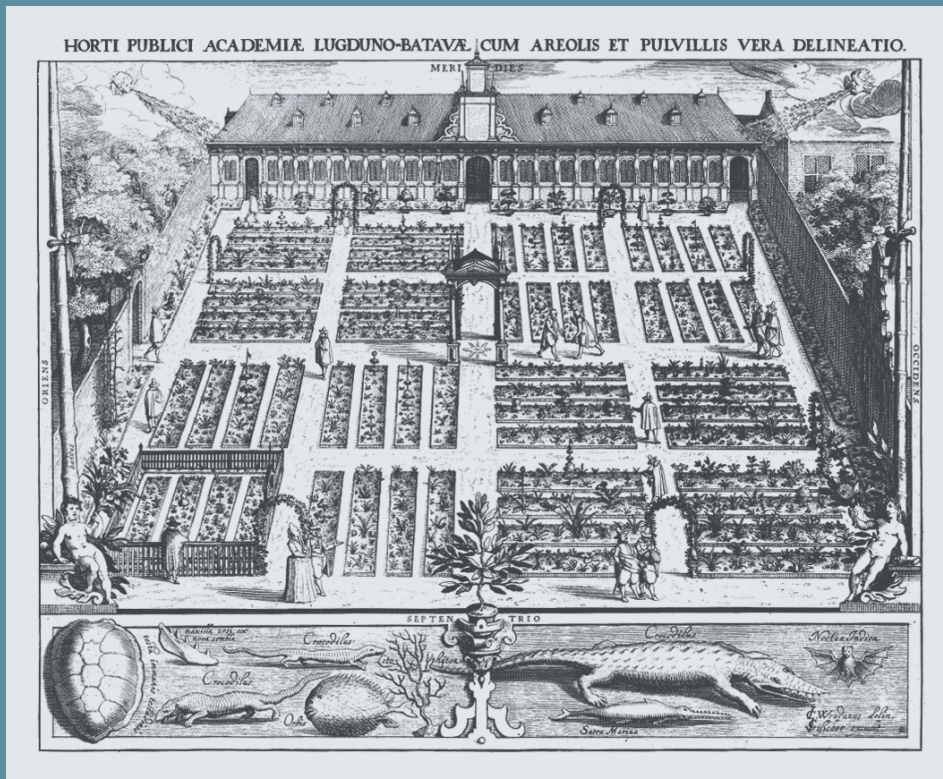
*Plan of the town of Delft, Willem Jansz Blaeu, 1649. Herb and vegetable gardens were planted throughout Delft to supply the population with food in times of siege. The Delft pharmacist Dirck Outgaertsz Cluyt cultivated his own plants and herbs in a plot on Rietveld.*



## Charles de l'Écluse (1526-1609)

The Flemish scholar, physician and botanist Charles de l'Écluse (Carolus Clusius) studied medicine and botany under the celebrated Professor Guillaume Rondelet in Montpellier. In 1564 he made a trip through Spain and Portugal, where he discovered, gathered and documented more than two hundred plant species. From 1573 until 1577 he served as imperial court botanist to Maximilian II in Vienna, where he planted a medicinal herb garden for the emperor. After Maximilian's death, de l'Écluse stayed on to study the local flora in Austria and Hungary, becoming the first scientist to organize botanical excursions into the mountains and generate interest in Austria's alpine vegetation. In 1594 he took a professorial appointment at Leiden University, where he also assumed supervision of the botanic garden planted by his assistant Dirck Outgaertsz Cluyt.

It was Clusius who introduced the Netherlands to the tulip, a bulb once found exclusively in Turkey. It all began with some tulip bulbs that he received from the Austrian ambassador to the Ottoman Empire and planted in the Hortus botanicus in Leiden. Fascinated by the bulb's flames and stripes, Clusius conducted research into these patterns that was to lay the basis for tulip breeding and for the flower bulb industry in the Netherlands. Not until the late nineteenth century did scientists discover that these flames and stripes were actually the symptoms of a viral infection. Besides tulips, Clusius also introduced Holland to the ranunculus, anemone, iris, daffodil, horse chestnut, flat bean, salsify and jasmine.



*The original Clusius/Clutius garden, circa 1610. In the 1930s the Hortus botanicus in Leiden created a reconstruction of the Clusius/Clutius-era garden based on original plans and plant inventories. In 2009 this garden was replanted in its historical location, where Cluyt's accomplishments are inscribed on a commemorative plaque.*



most other Dutch botanic gardens, the very oldest of which is that in Leiden. Yet Leiden's Hortus botanicus owes a huge debt to Delft, having been created with the assistance of the Delft apothecary Dirck Outgaertsz Cluyt, also known by his Latinized surname Clutius. Famed both at home and abroad for his knowledge of herbs, Cluyt also served as court apothecary to Prince William of Orange. In 1593 Cluyt was commissioned to plant the country's first botanic garden in Leiden, which was intended to support the university's instruction in materia medica – the study of the therapeutic properties of healing agents. The garden had been conceived by famed botanist Charles de l'Écluse (also called Clusius), but in the end poor health forced him to abandon the project and propose his highly esteemed colleague Cluyt to the university trustees to carry it out instead. The trustees were hesitant at first, preferring to appoint someone with an academic title, but in the end time won out and the Delft native was charged with setting out the Leiden hortus under Clusius' supervision. Not until 1636 would a second botanic garden be planted in Utrecht, followed by Amsterdam in 1638. Inspiring all of these gardens was the myriad of unfamiliar plants, herbs and spices that was being shipped to the Netherlands by the Dutch East India Company, and more in particular by efforts to learn as much as possible about this new 'green gold'. It was not

unusual for the company to commission botanists, physicians and apothecaries travelling out to the Dutch colonies to investigate which plants the natives considered to have useful or medicinal qualities. Merchants hoped to make a fortune marketing these plants, herbs and spices. Over time, the influx of these exotic species also transformed the botanic gardens in the Netherlands. Gradually, their emphasis shifted from the cultivation of medicinal plants to plant biology. Botanists were commissioned to describe all the newly discovered specimens, assessing their effects and organizing them in comprehensive taxonomies. Their work would ultimately lay the foundations for modern botany.

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### Technical education

Delft would have to wait another three hundred years for a botanic garden of its own. Though there were always physicians and apothecaries like Cluyt who cultivated small plots of herbs for their own use, these never approached the scale of a true hortus. Nor was there much incentive for such gardens. After all, Delft had no university up until the early twentieth century. Indeed, until the nineteenth century, it only had a grammar school, where boys from wealthy families were sent to be educated for careers in the Church or for university study. Those who chose to go to a university, which

## Dirck Outgaertsz. Cluyt (1546-1598)

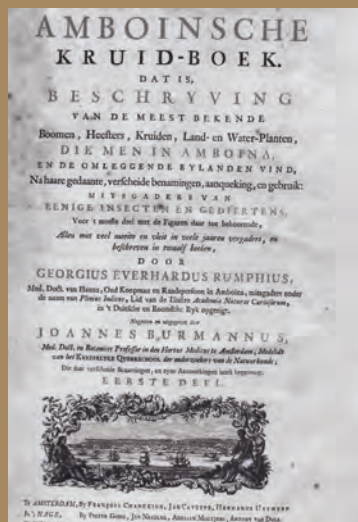
The Delft apothecary Dirck Outgaertsz Cluyt owned a large pharmacy on Wijnhaven called *De Granaetappel* (The Pomegranate). Among his customers was Delft's city physician Pieter van Foreest, one of the country's leading medics. Like most apothecaries of his day, Cluyt kept his own garden where he grew medicinal herbs. The garden was situated south of the Rietveld canal at the edge of town, where he owned five houses. In the courtyard he cultivated not only the herbs from which he made his medicines, but also various rare flowers and plants from around the world. Cluyt had befriended fellow practitioners in various other countries who shared his interest in botany and with whom he exchanged plants and seeds. Through this international network he was able to acquire many costly and rare specimens, including tulip, daffodil and hyacinth bulbs, all of which were still unknown in the Netherlands in those days. When Cluyt was appointed prefect of Leiden's botanic garden on 8 May 1594, it was on the condition that he would bring with him to Leiden all the plants from his own herb garden in Delft. Little by little he transferred his precious plants, until in late September of 1594 the new garden was complete. Cluyt was subsequently asked to teach at Leiden, at the hortus in summer and in the winter at the university, aided by illustrated books and a herbarium of four thousand dried plants from his own collection.

## Georg Everhard Rumpf (1627-1702)

The German-born natural historian Georg Everhard Rumpf, sometimes known by his Latin name Rumphius, made important contributions to the documentation and identification of tropical flora. Born in Hessen in 1627, Rumpf was a trader for the Dutch East India Company on Ambon. With not much else to do on the island, Rumpf found plenty of spare time to study the local flora and fauna. Botany was in fact his true passion, and his job afforded him ample opportunity to expand his scientific knowledge. He planted a small botanic garden, sent for books and corresponded with scholars across Asia and Europe. More important, however, were his exchanges with the islanders, who taught him the medicinal applications of plants. Though he had no formal training, Rumpf eventually became an authority on tropical crops. He recorded his knowledge in the *Herbarium amboinense* ('Amboinese herbarium'), a twelve-volume catalogue of 1,200 species of plants that grew on Ambon which was to become the basis for all subsequent research on the flora of the Moluccas. Penned with his goose quill, Rumpf's book was the labour of many years – years during which he also became irreversibly blind and lost his wife and two children to a tsunami following a submarine earthquake in the Banda Sea. In 1687 he had almost put the finishing touches to his life's work when a fire decimated his library, and with it all of his drawings and manuscripts. Having lost everything, Rumpf, now sixty, had to start all over again. Fortunately, he could rely on his son Paul and a draughtsman supplied by the Dutch East India Company for assistance. In 1690, six of the total twelve volumes were published in Batavia. Rumpf sent the entire manuscript by ship to the Netherlands, but it never arrived: the vessel was attacked by a French frigate and sank off the coast of Bordeaux. That the book was ever published at all was thanks to the governor-general of the Dutch East Indies, Johannes Camphuys. He had an avid inter-



The blind Rumphius, aged 68 years, drawn by his son Paul.



The *Herbarium amboinense* (Amboinese herbarium) was to become the basis for all subsequent research on the flora of the Moluccas.

est in science and was close friends with Rumpf, with whom he shared a passion for collecting specimens of plants and animals. Motivated by either impatience or foresight, Camphuys had copied out Rumpf's whole manuscript for his own use before it was dispatched on the ill-fated ship. When the work was lost, he personally drafted another copy and had it shipped to the Netherlands again in 1696. The manuscript reached its destination safely, but this time the directors of the Dutch East India Company threw a spanner in the works. Wishing to preserve its monopoly in the archipelago, the company was determined to prevent its British, Portuguese and Spanish competitors from gaining precious knowledge of the region's natural resources. Therefore, its directors refused to allow the book to be printed. In the end, Rumpf never lived to witness the publication of his life's work. He died in 1702; his *Herbarium amboinense* was not published until 1750. A new edition of the book appeared in 2011.

Rumpf's *d'Amboinsche Rariteitenkamer* ('Amboinese Cabinet of Curiosities'), cataloguing the island's shellfish and minerals, similarly went unpublished until after his death. It was later brought out by Hendrik d'Acquet, a physician, mayor of Delft and enthusiastic collector of natural artefacts and curiosities. With Rumpf's aid he was able to amass a large collection, portions of which he had documented in watercolour. In the 20th century Professor Gerrit van Iterson managed to track down several of d'Acquet's plants and to cultivate them in the Culture Garden of Technical Crops in Delft.



in those days were devoted wholly to scholarly study, went either to Leuven, which had had a university since 1426, or to Leiden, whose university dated from 1575. By the eighteenth and nineteenth centuries a new category of schools began to develop where military engineers could also be educated in mathematics and physics. Alongside training for military service, students at these 'artillery schools' received instruction in such 'practical' subjects as hydraulic engineering. The Artillery and Engineering School that opened at 95 Oude Delft in Delft in 1814 was one such school, preparing young men for careers in the army's artillery and engineering divisions and for civil engineering posts at the government's Department of Public Works and Water Management, which was responsible for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands.

This combination of military and purely technical education was wholly new. Previously, technical instruction had always been provided by regional water boards or private tutors. Delft's Artillery and Engineering School was short-lived, however, closing its doors in 1828. After this, those wishing to pursue an engineering career could choose between the Royal Military Academy in Breda or the Royal Naval College in Medemblik. But the orientation of these institutions was purely military, and they therefore did nothing to meet the huge demand for technically-trained civil servants. As a result, engineers often had to be hired from abroad. For a long time the Dutch government made no effort to change matters, until 1842, when the Royal Training Academy for Civil Engineers and East-India Officials was established in Delft. As far back as 1820 its director Antoine Lipkens (1782-1847), a land surveyor and cartographer, had been campaigning for a polytechnic training programme through which engineers and civil servants could receive combined academic and technical education. Though the government showed no interest, Lipkens persevered. In the years around 1840 he made a habit of stationing himself on the Interior minister's doorstep every week to pitch his ideas for the school. When this effort proved equally fruitless, he decided to change tack and approached his close acquaintance the crown prince and future King William III. The prince was more receptive to Lipkens's plan, especially after hearing his idea to create a joint course to train both engineers and

civil servants bound for the colonies in the Dutch East Indies, modern-day Indonesia. With Dutch prosperity in those days depending significantly on colonial revenues, a well-oiled local Dutch bureaucracy was vital to the success of its international trade relations. Therefore, solid training for Dutch officials was imperative.

The Royal Academy was established at 95 Oude Delft in the building left vacant by the Artillery and Engineering School, which was refurbished with a one-time state subsidy of 10,000 guilders. Its four-year courses trained students to become constructional engineers or mechanical engineers and for jobs in trade, while the curriculum for East India officials, also four years, comprised technical subjects such as mathematics, cosmography, physics, chemistry and architecture, alongside geography, history, regional studies, ethnology, religious laws, folk and state institutions, folk customs and instruction in eight indigenous languages including Javanese, Sudanese and Malay. The school proved immensely popular, not least because graduates were guaranteed a post in the Dutch East Indies. Financially, however, things were less rosy. The Netherlands was teetering on the brink of bankruptcy, with the French wars, British trade embargo and Belgian Revolution all having taken their financial toll. Whereas the economy of the southern part of the Netherlands was flourishing, the situation in the rest of the country was downright alarming. With no state funds to support it, the Academy had to rely on the city government for use of the building and on tuition fees to cover the salaries of its teaching staff and other expenses. Ultimately, this state of affairs could not help but affect the quality of instruction. In its straightened circumstances, the school could only appoint the cheapest lecturers, whose credentials sometimes left much to be desired. Its reputation suffered, and this was only compounded by the frequent misbehaviour of its young students. In 1859 measures were finally taken with the appointment of Johannes Keurenaer as its new director. A retired major of the Dutch East Indies army engineering corps and every inch the military warhorse, Keurenaer was given the explicit task of restoring military discipline. Besides this, he was also charged with implementing a decision handed down by the Ministry of the Interior to house the student body in barracks. For this an extra wing was to be added to the Academy building. But Keurenaer's zeal soon threatened



*The Royal Academy at 95 Oude Delft around 1855.*

to spill over beyond his mandate for education into meddling in the school's burgeoning student society life, and especially the Delftsch Studenten Corps, a student association which had been formed in 1848. For the students, this interference was the last straw. They organized a walkout and the Academy was forced to close its doors from 22 November 1861 until 21 January 1862. Not knowing where else to turn, the members of the city council and the school's students and teaching staff – who had not been consulted on Keurenaer's appointment – appealed to the king for help. He responded by convening a committee to investigate the matter, and subsequently another committee was assigned to oversee reforms at the school. The reforms were never realized however, and in 1864 the Royal Academy was dissolved. In its place there now came a polytechnic school designed on the educational model that Lipkens had proposed many years before.

### East Indies Institution

Paving the way for this new form of education was the Secondary Education Act – a law championed by the liberal minister of the Interior Johan Thorbecke that also created other new models of secondary education, including 'higher civic

education' (Hogere Burgerschool, HBS) and secondary schools for girls. The new Polytechnic School was a slimmed-down version of the Royal Academy. The Dutch government had decided to transfer training for colonial service to the state school in Leiden, the precursor of what is now the Royal Netherlands Institute of Southeast Asian and Caribbean Studies. It also decided to enact legislation governing the quality of education in the language, regional characteristics and ethnology of the Dutch East Indies, among other things requiring students to sit a state exam for civil servants. Those who got the highest marks on the exam had the best chance at a job. The state school at Leiden did not have a monopoly on training for this exam, however, and in principle any town, organization or institution could offer preparatory courses. Having suffered the bitter blow of the loss of the colonial civil service programme – and its substantial attendant revenues – to Leiden, Delft's city administration lost no time in capitalizing on this opportunity. In 1864 it decided to establish a programme of its own, in the form of the Institution for Education in the Language, Region and Ethnology of the Dutch East Indies, or the East Indies Institution for short. With the additional foundation of a new five-year higher civil school the following year, Delft was now able to offer comprehensive training for colonial civil service. To ensure thorough alignment between these programmes, pupils at the higher civil school could already start attending lectures at the East Indies Institution in their fourth or fifth year.

Meanwhile, the competition in Leiden was struggling. Its aspiring civil servants complained that the curriculum was much too academic, as well as considerably longer than that in Delft and more expensive. Not surprisingly, most students preferred the programme in Delft, where 759 students would pass the state civil service exam between 1864 and 1891. In 1876, the government closed the school in Leiden, leaving Delft as the only option for those seeking a position in the Dutch East Indies.

Yet the success of Delft's East Indies Institution was also short-lived. After the repeal of the Cultivation System in 1870, the number of colonial posts for Dutch civil servants gradually tailed off. By 1885, only a handful were still being deployed to the East Indies. In Delft, competition among students grew fierce, as graduates who were unable to secure a post had few other prospects.



Inevitably, enrolments dwindled and dropouts increased. In 1901, the East Indies Institution closed its doors. Its ethnographic collection, amassed over the years to support the curriculum, was transferred to the Nusantara ethnological museum in 1911. Though mostly acquired from the government, parts of the collection came from officials and alumni who had gone to the colonies and sent back objects that might help future civil servants gain a better grasp of Southeast Asian culture. Thanks to continued donations by private patrons and collectors, this collection continued to grow even after the East Indies Institution closed. When the Nusantara Museum was dissolved in 2013, the collection numbered some eight thousand objects, which were divided between the National Museum of Ethnology in Leiden and the Rijksmuseum and the Tropenmuseum (Museum of the Tropics) in Amsterdam.

Netherlands' colonial holdings in Southeast Asia. On the contrary, in the second half of the nineteenth century the Dutch East Indies formed the backbone of the country's economy. Apart from supplying an important source of income from international trade, they also met the increasing demand for raw materials created by the Industrial Revolution. In the Netherlands, the first factories began operating in 1870. Burgeoning new industries required raw materials from plants to manufacture their pioneering products. The margarine factory founded by Anton Jurgens and Simon van den Bergh, for instance, depended on copra and palm oil, and Jacques van Marken's oil factory relied on groundnuts for the production of salad dressing. The East Indies had all these natural resources in abundance. All that was necessary was Dutch technological ingenuity to process them.

### Industrialization

The end of the East Indies Institution by no means signalled any decline in the importance of the

*Labourers unloading a ship on Wateringseweg at the warehouse of the Dutch Oil Factory (Nederlandsche Oliefabriek). Raw materials, such as groundnuts, were transported mainly over water.*



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**Dutch industry taps into colonial raw materials**

# Applied research in the tropics

**In the nineteenth century, a combination of scientific interest, economic motives and nationalistic concerns leads to a revival of interest in the Dutch East Indies. For several decades, professional testing stations form the scientific backbone of the archipelago.**





From as early as the sixteenth century the Dutch economy and political establishment were closely intertwined with those of the Dutch East Indies. By the seventeenth century, in the Dutch Golden Age, Dutch East India Company ships were bringing exotic herbs and spices like nutmeg, clove and cinnamon to the Netherlands. These days we use such herbs mostly for cooking, but back then they were popular mainly because of their supposed medicinal properties. Mace was recommended as a remedy for stomach complaints, colds and lung conditions, for instance, and nutmeg for stomach complaints, colds, diarrhoea and pimples. At a time when people's health in general was quite poor, there was a constant high demand for products of this kind. Dutch East India Company port cities such as Amsterdam, Delft, Hoorn and Middelburg entered a period of rapid economic development as the international trade created more jobs and boosted prosperity. Huge fortunes were made and merchants showcased their wealth in grand canal houses.

The Dutch East India Company was determined to acquire a full-scale monopoly of the shipping trade. Threatening force if necessary, it signed contracts with various local rulers to secure this privilege. Although the company was interested in a multitude of products, the one it coveted above all was Manila hemp (*Musa textilis*). An inedible cousin of the ordinary banana, this plant's fibres have the unique quality of being resistant to salt water. This made it the perfect material from which to fabricate the ropes of ships' rigging and caulking<sup>1</sup> to keep them watertight. Realizing its potential, the Dutch East India Company launched a strategy of conquering every single sultanate in which this profitable plant grew, and in so doing gained a global shipping monopoly. As well as being directly responsible for much of the Dutch East India Company's trading profits, Manila hemp indirectly also played a major role in the development of the Dutch colonies. Originally, the archipelago consisted of a diverse constellation of islands with their own disparate cultures, religions, flora and fauna. The Dutch East India Company strung those which had Manila hemp



*Batavia Castle, stronghold of the Dutch East India Company. Oil painting by Andries Beekman, 1656.*

together, much like beads on a necklace, and in the process created the contours of modern-day Indonesia. Only the Moluccan island group was an exception, where instead of Manila hemp, spices such as pepper offered lucrative export prospects.

In the early days no one paid much attention to the interests or welfare of the native Indonesians. Everything revolved around trade and profit. The nineteenth century brought no change in this respect. The colony was and remained a cash cow whose sole purpose was to line Dutch pockets. The Netherlands demanded that the indigenous



*The unique properties of Manila hemp motivated the Dutch East India Company to colonize large parts of the Indonesian archipelago. There is less demand for the fibre nowadays, though it is still used to produce special types of paper for tea bags, banknotes and medicine capsules, among other things.*

[ 1 ] Caulking, also called calking or calefaction, is a method used to seal seams in a ship's wooden deck or hull, traditionally using unravelled cordage made from natural fibres, usually hemp.

population hand over twenty per cent of their harvest, or else pay the equivalent in tax. In 1830 this arrangement was exchanged for the Cultivation System. Now, the natives were compelled to use twenty per cent of their land to raise compulsory crops such as pepper, coffee, sugar, tea and tobacco, for which there was a large market in Europe. The price the natives were paid for these crops was fixed by the Dutch government. To oversee the shipping and worldwide sale of these exports, King Willem I established the Netherlands Trading Society (NHM) in 1824. As he was the society's main shareholder, a large portion of the immense profits went directly into the 'merchant-king's' coffers. In its early years, the NHM operated as an import and export company, its objective to expand existing trade relations and tap into new commercial channels. But the vast territory it sought to cover made this difficult. Not until the trading society reduced its focus to concentrate almost solely on the Dutch East Indies would it achieve real success. Starting in 1850 it began buying up plantations, in addition to which it provided financing for companies that ran their own plantations in the colony.

### Industrialization and ethics

Indonesian regents and village chiefs played an important role in the Cultivation System. They chose the land to be cultivated and how the work would be divided, and were responsible for ensuring that the products were delivered on time. In exchange, they enjoyed a share of the harvest. Of course, this was the perfect recipe for abuses of all kinds, so that the best land came to be reserved for the European market and agricultural labourers went underpaid.

In the second half of the nineteenth century, as famines wiped out large parts of the native population, the Dutch came under increasing attack both at home and abroad for the way they were exploiting their colony. This put the Netherlands in a difficult position. With the Dutch East Indies as vital to its economy as ever, the government was unwilling to relinquish it as a source of revenue, and refused to change its policy. It was willing to make a concession, however: henceforth, the colonial contribution to the mother country would no longer come at the expense of the native population. The Dutch administration now had to find a way to accommodate the native Indonesians while at the same time retaining, and if possible expanding, the colony's economic benefits. In 1870 the Cultivation System was repealed for almost all products, with the exception of coffee and opium, whose cultivation and sale were simply too lucrative to give up completely. At the same time when the Cultivation System was dismantled, two new laws were created that would make it easier to establish private enterprises in the Dutch East Indies. One was the Agrarian Act, which laid down land ownership rights on the island of Java, effectively guaranteeing the native people's right to their land holdings. All the remaining land, of which there was a great deal, was the government's to lease out. For many enterprising Westerners this was an open invitation to settle in the Indies and establish large plantations there. The Sugar Act was more explicit. It specifically enabled European private enterprises to establish sugarcane plantations in the Dutch East Indies. Their sugar was processed in Dutch sugar refineries and then shipped out to the international market. The opening of the Suez Canal in 1869 sped this export trade considerably, with steamboats able to complete a journey that had once taken months in mere weeks. Propelled by Dutch



Published in 1860, Eduard Douwes Dekker's (also known as Multatuli) novel *Max Havelaar* denounced the corrupt government of the Dutch East Indies. It was published in forty languages and had an enormous influence on Dutch colonial politics.





*Coffee plantation in the Padang Highlands. After the Cultivation System was dismantled it became easier to establish private enterprises in the Dutch East Indies. Many Western entrepreneurs decided to settle in the Indies and started large plantations there.*

investments, the colony developed a large-scale industry with a global market. It became a major supplier of food and feedstock to Europe and North America, with exports including quinine, kapok (Java cotton), pepper, rubber, copra, sugar, tea, coffee, palm oil, petroleum, tin, tobacco, cotton and rice.

Though much of the archipelago was now in Dutch hands, there was one area where the Netherlands had no control. The independent Islamic sultanate of Atjeh on the island of Sumatra refused to submit to Dutch rule. But its wealth of fertile farmland – cultivated for peppers, among other things – made it extremely appealing to the Netherlands. Besides this economic motive, the Netherlands also had strategic reasons for setting its sights on Atjeh. The sultanate's position gave it control over the Strait of Malacca, one of the most important shipping routes in the world as well as the shortest between the Indian and Pacific oceans. In fact it was this that most interested the Netherlands. The Dutch therefore decided to appropriate this piece of the Indonesian archipe-

lago as well, albeit in the guise of a noble attempt to stem piracy in the Strait of Malacca. The result was a bloody war leading to many thousands of casualties on both sides. Though officially the conflict only lasted until 1901, guerrillas continued to strike for many years.

After the Atjeh War, it became easier for the Netherlands to ship tropical crops back home, where advancing industrialization was feeding steadily increasing demand for these products. After all the years of fighting, however, Dutch colonial rule now underwent a remarkable change, shifting away from its focus on economic profit. Motivated by a new ethical policy which dictated that the Netherlands should repay the debt of honour it owed for centuries of exploitation, the Netherlands began investing in the development of the colony and its inhabitants. To begin with, the Indonesian people were given a limited local and regional share in territorial governance. The Netherlands also made investments in education, healthcare and infrastructure, built irrigation works, supplied information on agriculture and



fishing methods and provided funds for scientific research to improve crop quality. Granted, the latter was not entirely new. A substantial amount of scientific research had been taking place in the colony since as far back as 1816. While in the Netherlands the Industrial Revolution had yet to begin and technical innovation was still in its infancy, in Southeast Asia the Dutch were running a well-oiled imperial machine in which science and technology played a pivotal role. Primarily responsible for this was a German academic, Caspar Reinwardt (1773-1854), who lived and worked in the Netherlands and had made a distinguished name for himself as a professor of chemistry, botany and natural history. Under the rule of Louis Napoleon his career took a surprising turn. Appointed the first king of Holland by his brother, Napoleon Bonaparte, Louis Napoleon had a keen interest in science. In 1808 he established the Royal Institute, later to become the present-day Royal Netherlands Academy of Arts and Sciences. Shortly thereafter he appointed Reinwardt to be the director of his Jardin du Roi, entailing responsibility for a zoo, a botanic garden and a natural history collection.

Initially this colourful menagerie was housed at Soestdijk Palace near Baarn; later it was moved to Villa Welgelegen outside Haarlem. In around 1810, the natural history collection was transferred to Amsterdam, to be put into storage in the attic of the Royal Palace on Dam Square. Four years later, with Louis Napoleon no longer in the picture, the collection was moved again, this time to the Trippenhuys mansion in Amsterdam, where it joined the art museum that would later become the Rijksmuseum.

### National Botanic Garden

In 1815 the Dutch administration sent Reinwardt to the Dutch East Indies with the mission to initiate scientific research. This, it hoped, would put the Netherlands on the path to becoming a great and powerful nation once more, as it had been before the French occupation. Scientific research, after all, would give the country more standing. Reinwardt was appointed to head the Department of Agriculture, Art and Science on Java and the surrounding islands, and in this capacity he

*Under the inspiring leadership of Melchior Treub (left) the National Botanic Garden evolved into the world's first research centre for tropical plant biology.*

