In splendid isolation

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In splendid isolation

A history of the Willie Commelin Scholten Phytopathology Laboratory 1894-1992

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Translated from the Dutch by Beverley Jackson

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Illustration cover: logo of the Willie Commelin Scholten Phytopathology Laboratory.

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Prologue

Seven Women and a Diseased Elm

May 1995. The harsh whining of chain saws pierces the air of the sleepy neighbourhood. The Parks and Public Gardens Department has started work bright and early and two men are sawing down a twenty-metre high elm in an enclosed garden in the western district of Amsterdam. Hanging from ropes like mountaineers, the men slice off the tree's branches one by one, each time with a single sweep of the saw. The lopped branches swish down to the ground below. A few hours later, the colossus has been reduced to a pathetic stump. The houses on the other side of the square suddenly seem a few metres closer.

A furious resident phones the local authority. The elm was diseased, the official explains amicably, and there is no cure for elm disease. Only by chopping the tree down and removing it can you prevent the disease spreading or – more important still in a dense residential neighbourhood – make sure that the tree will not come thundering down of its own accord, toppled by strong winds.

Local residents had not even noticed anything wrong with the tree. How you can tell that an elm is diseased actually? 'It's an insidious process', explains Doekle Elgersma, plant pathologist at the University of Amsterdam. The first symptoms appear in the spring. The leaves on the youngest twigs wither and become discoloured, as if autumn has already come. Then they die. Some fall to the ground, and others stay hanging in the tree like little dead flags. Then, in the summer, bare patches appear in the full green crown of the tree. The patches are bigger the following year, and bigger still the year after, until the doomed tree is eventually completely bare. By then it won't take much to blow it down. The entire process of death can last as long as much as ten years.

Elgersma suddenly demands: 'Did you know that this disease is called 'Dutch elm disease' all over the world because the most important discoveries about elm disease were made by seven Dutch scientists? And that all seven were women?'

He shows me a bluish-green book. The title on the cover, in silver letters, is *Dutch Elm Disease: The Early Papers, Selected Works of Seven Dutch Women Phytopathologists*.[1] I leaf through it casually. There they all are, complete with photographs and nicknames. That conjures up a jovial atmosphere, as if they had been not just colleagues but also members of a sort of social club. Their dates strengthen this impression. The eldest, Barendina Spierenburg, was born in 1880 and died in 1967. Then came Johanna Westerdijk, born in 1883, died in 1961. The other five were at least fifteen years younger than these two, but were all within at most seven years of the same age. So they must have known each other.

I thank him and take the book home with me. Seven women, it sounds like an Old Testament prophecy; is it a coincidence?

In the summer of 2000 I received a telephone call from Bob Schippers. The Willie Commelin Scholten Phytopathology Laboratory had closed in 1991, and the Willie Commelin Scholten Foundation for Phytopathology was looking for someone to write a history of the Laboratory. Its closure had not signalled the end of Dutch phytopathology, Schippers hastened to explain – quite the contrary – but it *had* brought to an end the almost century-long existence of this Laboratory with the curious long name. My thoughts immediately flew to the bluish-green book.

Six of the seven women had worked at that Laboratory. I had never shaken off a certain curiosity about the connections between these women, the Willie Commelin Scholten Phytopathology Laboratory, and elm disease; this was a unique opportunity to find out the underlying story. Of course I would be happy to write that history, I replied.

I soon discovered that the bluish-green book on Dutch elm disease was not the only one to discuss the dominant role of women in the history of the Phytopathology Laboratory. Googling 'Willie Commelin Scholten' with the Dutch word for history took me straight to the home page of the *Jaarboek voor Vrouwengeschiedenis* (Yearbook of Women's History), followed by the 1898 Nationale Tentoonstelling van Vrouwenarbeid (National Exhibition of Women's Labour) and the local paper produced by the Society of the 'Professors' and Burgomasters' Neighbourhood', announcing the first woman professor of law in the Netherlands. These three links all appeared before the first one relating to phytopathology. So there was clearly some link between women and the history of the Phytopathology Laboratory, quite aside from elm disease.

[1] F.W. Holmes and H.M. Heybroek, *Dutch Elm Disease: The Early Papers, Selected Works of Seven Dutch Women Phytopathologists*, APS Press, 1990. F.W. Holmes was a visiting scientist at the Phytopathology Laboratory from 1970 to 1971.

The reason for this association, which at first sight seemed so odd, soon became clear. The Phytopathology Laboratory had been founded in 1894 with the private capital of Mr and Mrs Commelin Scholten of Amsterdam, to commemorate their son Willie, who had died at an early age. That explained the name. But when its first director, Jan Ritzema Bos, had left the Amsterdam Laboratory after eleven years to lead the newly established Institute of Phytopathology in Wageningen instead, Johanna Westerdijk, a woman of only 23 years of age, had been chosen to succeed him.

For decades after that, the Laboratory had a woman director. Westerdijk had not retired until 1952. Under her captaincy the Laboratory had grown from a small private establishment to an internationally renowned centre of phytopathology. In 1920 it moved from modest-sized premises in Amsterdam to the grand Villa Java in Baarn, where it remained until its closure.

Westerdijk was appointed extraordinary (that is, part-time) professor of phytopathology at Utrecht University in 1917, followed in 1930 by the same – simultaneous – appointment at the University of Amsterdam. A total of fifty-five students gained doctorates under her supervision, twenty-six of whom were women. The professorships, in particular, proved to be crucial in determining the Phytopathology Laboratory's image. All the websites I consulted noted that Westerdijk had been the first woman professor in the Netherlands, and that she therefore served as a rich source of inspiration for historians interested in the role of women in science.[2]

After Westerdijk's departure, one of her former PhD students, Louise Kerling, took over the directorship as well as both part-time professorships. She stayed at her post until 1970. Kerling added a new wing to the Laboratory as well as installing modern equipment and climate chambers, all of which opened up new avenues of research. Not until Kerling herself left was the era of women's dominance in Baarn finally at an end. And as far as these sources are concerned, that is the history of the Willie Commelin Scholten Phytopathology Laboratory in a nutshell. For the rest of the story, the interested outsider will have to consult other sources.[3]

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[2] *Inter alia* M. Bosch, *Het geslacht van de wetenschap. Vrouwen en hoger onderwijs in Nederland 1878-1948*, Amsterdam, SUA, 1994.

[3] One such publication being *Communication* 75 of the *MPLWCS* no.75, 1969; a jubilee issue written by Kerling to mark the Laboratory's 75th anniversary. Another, published in 1997, is a 'Historical Review' in the *European Journal of Plant Pathology*, in which former director Bob Schippers and the former chairman of the Willie Commelin Scholten Foundation for Phytopathology Ben Roosje discuss not only the history of the Phytopathology Laboratory, but also the future of the foundation; see L.C.P. Kerling, 'Phytopathologisch Laboratorium "Willie Commelin Scholten" 18 december 1894-18 december 1969', B. Schippers and G.S. Roosje, 'Hundred years of history and the future of the Foundation "Willie Commelin Scholten Phytopathology Laboratory"', *European Journal of Plant Pathology* 103, 1997, pp. 667-671.

The Laboratory's recent history proved to have been documented by its own staff. Their version of events is self-evidently coloured by their own interests. Interestingly, the present and future occupy at least as important a place in these writings as the past. Instead of an emphasis on the role of women we find a curt recapitulation of the most recent trends in the Laboratory's research, the international fame it reaped from them, and the way in which the research was organized.

The man who took over the directorship and both professorships after Kerling was Koen Verhoeff, who had gained his doctorate at Utrecht. He divided the scientists into three research teams, around the subjects 'Susceptibility and Resistance', 'Ecology of Pathogenic and Non-Pathogenic Micro-Organisms', and Virology. His successor Bob Schippers, who took over at the end of 1986, had been awarded his PhD by the University of Amsterdam. He changed the course of the existing research by actively seeking cooperative frameworks with molecular biologists working elsewhere. By then, the end of the Willie Commelin Scholten Phytopathology Laboratory was already in sight; but the research itself was in no such danger.

Soon after Schippers' arrival, the two remaining research teams were split up, one being transferred to the University of Amsterdam and the other to Utrecht University. The research once performed in Baarn was continued within the structure of the Department of Molecular Cell Biology and the Department of Plant Ecology and Evolutionary Biology, respectively. In the early 1990s the buildings and ground in Baarn were sold and vacated, and the Willie Commelin Scholten Phytopathology Laboratory ceased to exist.

I had visited the abandoned Villa Java in May 1995. A sumptuous building in colonial style, with high windows and elegant bay windows. It stood in a large garden enjoying the shade provided by numerous great trees and surrounded by muddy paths. The fire brigade had conducted a drill there and had left a smoke-blackened child's cot in the corner of a room. The air was heavy with the stench of burning. The basement was under several inches of water, and disused wires dangled from the ceiling. A few torn sheets from a sex magazine were scattered over the floor. In the attic I came across some books covered with a thick layer of dust: PhD theses, as it turned out.

Long after my visit, at the end of the 1990s, a demolition crew arrived. The caterpillar tracks of the mechanical scoops scored deep ruts in the garden around the Villa. Within a few weeks the entire complex had gone; little more remained of the Willie Commelin Scholten Phytopathology Laboratory than a budget, a large archive collection, and the Foundation's executive board.

I was well aware by then that the history of the Willie Commelin Scholten Phytopathology Laboratory could not be equated with the research on elm disease, although this was the Laboratory's chief claim to fame. That other success story – the predominance of outstanding women scientists – was also only part of the story.

Correcting these imbalances in perception became one of the objectives of this book. If the Laboratory did not derive its relevance solely from the sex of its scientists or its focus on diseased elms, what were the other important factors? Part of the answer lay in the terse (and to lay readers fairly inscrutable) writings of the Baarn phytopathologists themselves. Incorporating their own narratives into the existing history thus became my second objective.

In the summer of 2002, Nyckle Fokkema, the then chairman of the Willie Commelin Scholten Foundation for Phytopathology, parked outside my office in the western district of Amsterdam. In the back of his car were 22 cardboard boxes containing all the remaining written sources from the Laboratory. The boxes had been in storage at the administrative centre of Utrecht University for years. No one had ever sifted through them to classify them or even to draw up an inventory. Their content was largely unknown. We unloaded them and carried them into my office.

A few years earlier, the Foundation had set up a supervisory committee with which agreements had been made on the writing of the history of the Willie Commelin Scholten Phytopathology Laboratory. I would be able to draw freely on their collective memory. That a professional science historian, in other words a relative outsider, would write their history not only had their consent, it was their express wish.

And the archives – obviously a primary source of information – would be relocated to my office for as long as proved necessary. Now, they were finally here. As happy as a child on Christmas morning, I started to unpack the boxes.

1 What did Willie want?

Caspar Willem Reinhard Commelin Scholten died on Friday, 30 June 1893, exactly one week before the end of the academic year. According to the record of his death in Amsterdam's municipal archives, he was, 'a *Philosophiae Naturalis Candidatus* [bachelor of natural philosophy] by occupation', and lived in Amsterdam. He was twenty-five years old. Yet Amsterdam's archives reveal nothing about the cause of death, so that the inquiry moves to Apeldoorn, the city where he died.

In the card-index boxes of Apeldoorn's municipal archives, there is no mention of a 'Commelin', 'Scholten', or any combination of the two. In the microfiche death records, however, his name does appear. The record of Willie's death has been written in a flamboyant hand. Two witnesses had stated to the official of Apeldoorn's Registry of Births, Marriages and Deaths that Willie had died 'at 2 p.m.... in the home of Dr. Pierre François Spaink in this municipality'. *Erica*, the address-book and yearbook of the municipality of Apeldoorn, carries a listing in 1893 for 'Spaink ... physician, medical director of the sanatorium for the mentally ill, on Loolaan.'

In the annals of *Erica*, the name of Spaink, with this description, first occurs in 1892. According to the volume published in 1963, the last one in the archives, Bosrust private sanatorium for the mentally ill was located at Loolaan 59. Its medical director, Spaink, had moved to Utrecht with his family in 1909.

Apeldoorn's municipal archives contain a large collection of historical photographs and postcards. In one of the blue files with old photographic material is a postcard with a view of a magnificent villa: the caption tells us that this was Bosrust Sanatorium on Loolaan, Apeldoorn. The institution appears to be in the middle of a wood, but this is an illusion. Loolaan is an avenue lined with a wide row of trees. 'Huize Boschrust', to give the villa its old name, is set back at some distance from the Loolaan. It is a capacious building, with a circular tower beneath a pointed roof serving as watchtower. It has numerous large windows, including generous-sized, high, bay windows.

The building is entirely in tune with its surroundings. A little further down the road stands the school that was attended by the children of the royal household, next to which is a café-restaurant. All the buildings are separated by large gardens and trees, so that each one is framed in its own dignified surroundings. Loolaan broadens out into a park at one end; this is where the drive leading to Het Loo Royal Palace begins. A small electric tram turns in a little circle there and trundles back where it came from. The whole avenue exudes an atmosphere of the elegant, wealthy establishment. So this was where Willie died.

He had committed suicide, it was whispered years later. But that can no longer be proved. Willie's parents placed a death notice in the daily newspaper the *Algemeen Handelsblad* on 4 July: 'Died 30 June 1893, in Apeldoorn, our only child, Mr C.W.R. Commelin Scholten, Bachelor of Natural Philosophy at the University of Amsterdam.' That same day they buried their son at the General and Roman Catholic Cemetery, Heemstede.

Who was Willie? What would he have wanted to do with his life? He came from an upper-crust background – a Christmas child, he was born in Amsterdam on 25 December 1867. Both his father, Caspar Willem Reinhard Scholten (knight in the Order of the Dutch Lion), who was almost fifty-four years of age when his son died, and his mother, Hendrina Hermina Commelin, who had just celebrated her fiftieth birthday, came from prominent local families. The coat of arms borne by the Scholtens, a patrician family, invokes a tradition of trade and regentships reaching back for centuries.[1] Among Hendrina's forebears were several famous printers, a historian of the city of Amsterdam, and two professors of herbology at the Athenaeum Illustre, the precursor of the University of Amsterdam. Commelinstraat in the eastern district of Amsterdam is named after one of them.

Father Scholten – with his long sideburns and high forehead an archetypal late nineteenth-century aristocrat – was an ambitious businessman.[2] He started his career in a managerial position within a traditional Amsterdam sailing ship navigation company, but he soon found his feet as a forward-looking executive. Suriname could become the Netherlands' second Java, he predicted: provided that overseas trade was driven not by the wind but by men and machines. Ocean liners had everything that the fragile sailing ships lacked: indestructible, they held unswervingly to their course, and their size almost defied the imagination. Furthermore, you could rely on them, which could certainly not be said of the sailing ships, with their vulnerability to

[1] See also *Nederlands Patriciaat* 48, 1962, p. 321, p. 333.

[2] All the details concerning the founding and history of the Royal West Indian Mail Service (Koninklijke West-Indische Maildienst) derive from GAA, persverzameling Hartkamp, box 68.

wind and current, which constituted the majority of vessels rolling in the seas of the world. To build three iron steamships in the Netherlands, each weighing over 1,000 tons, and to equip them for passengers along the lines of French ships, he calculated that 1.2 million guilders would be needed in starting capital, an investment that would soon repay itself many times over.

On Thursday and Friday, 25-26 May 1882, four prominent and eminently reliable citizens opened subscriptions for 1,200 shares of 1,000 guilders each (each one divisible into subshares of 500) for the launch of the West Indian Mail Service, the first Dutch steamship navigation company that would run a regular service to and from the West Indies. King William III looked favourably on the plan and warmly commended the investment to his wealthy friends. The government also agreed to support the enterprise, and announced that it would use the new service to transport mail, goods, and colonial officials. Two years (and a minor change of name) later, Scholten and his co-director George, Baron Tindal – who was also chamberlain to King William III and a member of the supervisory board of 'Nederland' Steam Navigation Company – proudly presided over the launch of the Royal West Indian Mail Service.

On 28 March 1884, they watched as their first ship, the Oranje-Nassau, cast off and majestically drew away from the jetty of De Ruyterkade, Amsterdam. Cutting right through the drone of the machines in the ship's belly and the crowds' loud cheers, the little orchestra stolidly struck up first the national anthem *Wien Neerlands Bloed* and then *Directlijn Marsch*, a piece composed especially for the occasion. According to a reporter for the monthly magazine *Eigen Haard*, the ship was accompanied by 'merry dancing crowds' all the way to the port of IJmuiden, where a glorious glitter of nocturnal fireworks lit the sky as it steamed into the open sea, towards Suriname, Trinidad, Curaçao, Porto-Bello, and LaGuayra.

That same year, three steamships of the new line initiated and maintained a highly successful monthly service between the Netherlands and the West Indies. On the outward journey, the fleet carried butter, cheese, Dutch gin, and potatoes, as well as colonial officials; on the return journey the hold was filled with cocoa, sugar, and bananas. From then on, father Scholten rubbed shoulders with the cream of society, and rejoiced in the warm personal interest of the king. In May 1909, sixteen years after his son's death, he retired as director at seventy years of age.

Although his wife, Hendrina, had no official occupation, she possessed no less vigour and zest for innovation than her husband. She dedicated herself to setting up courses in cooking and domestic science at the local girls' school, and founded the women's museum of reading on Vondelstraat. Later historians labelled her a feminist – although she certainly did not count herself among

Cover of a leaflet on the Royal West Indian Mail Service. Amsterdam Municipal Archives.

the feminists whose cause was championed so vociferously by her neighbour, the famous Aletta Jacobs.

Hendrina, like her son, had been raised an only child; her brother had died shortly after birth, when she was only two years old.[3] As if to emphasize the importance of his existence, Willie bore the last names of both his parents, besides all three first names of his father.

There is a painting in Utrecht University Museum, depicting mother and son in the style of the Hague School. Dreamily romantic, their two heads at the same height, they gaze at the viewer. She is seated, in a pink dress, her black hair tied back in a bun; while her son, still a small boy, stands beside her, his arms around his mother's neck. He is bare-kneed, and wears knee-length socks. When the portrait was made, and by whom, is unknown; but regardless of the date, it reflects the tragedy of the young man's sudden death in 1893.

[3] For the genealogy of the Commelin family, see *De Nederlandsche Leeuw*, 1923, pp. 152-157; *De Nederlandsche Leeuw,* 1942, pp. 33-35; *De Nederlandsche Leeuw,* 1958, p. 514.

Willie and his mother. Universiteitsmuseum, Utrecht University Museum.

Willie studied biology at the University of Amsterdam. He had enrolled in the university's fraternity on 21 October 1886, less than two weeks after Frits Went had been awarded his PhD in the same faculty, with Hugo de Vries as supervising professor. These are the two men whose views would determine the destiny of the Willie Commelin Scholten Phytopathology Laboratory for almost half a century.

He was 19 years old at the time – according to a photograph dating from this period a well-groomed, handsome young man, with a white collar and a tie, a small flaxen moustache, full lips, and short sideburns. His hair gleams with pomade and is combed back in a tight parting, his eyes gazing just past the lens into the distance. He was a good, sincere, and modest young man, his parents said after his death. The photograph and the portrait in the University Museum are the only images of Willie that have been handed down to us.

From 1886 onwards, Amsterdam's student almanac lists his name faithfully every year in the list of fraternity members: 'Scholten (C.W.R. Commelin), Tesselschadestraat 9.'[4] In other words, he continued to live with his parents, in one of the superb mansions overlooking the Vondelpark. In the lovely back garden on the corner of Tesselschadestraat and Roemer Visscherstraat, father Scholten, who owned buildings on both streets, had had a simple laboratory built for his son. A conservatory followed later on, which became one of Mrs Scholten's favourite retreats. The garden was the epitome of good taste and refined architecture.

Willie was a sixth-year student when his name was mentioned for the first and only time in the letters of his mentor, Hugo de Vries. 'My private seminars are poorly attended', De Vries wrote to his former student Went on 16 February 1892. 'Verschaffelt (the most attentive) has gone, Willy Scholten has broken his leg in a riding accident, De Meijere has taken his Master's examinations. Now there is only Krelage, who is no longer a student, but who always comes in all the way from Haarlem, Goethart (did I already mention that he has passed his MO [secondary school teaching certificate], in The Hague?), Miss Lourens, who is studying for an MO, and two Groningen students, Hartkamp and Versluys.'[5]

For the rest, all that remains of him is a lecture notebook with a few pages of writing. It was discovered in the archives of the Willie Commelin Scholten Foundation for Phytopathology, in a brown folder among a pile of letters and extracts of the deed of foundation. The year in which it was written is uncertain, and we cannot even be sure that it was Willie's, though this seems likely,

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4 *Almanak van het Amsterdamsch Studentencorps*, 'Naamlijst der leden van het Amsterdamsch Studenten Corps', UVA.

5 Archives of Hugo de Vries, MB, Leiden.

Caspar Willem Reinhard Commelin Scholten Jr. Archives of the WCS, Haarlem.

given the handwriting and the place where it was found. The content suggests that it may be the notebook that Willie used just over a year before his death, during Hugo de Vries's private seminars.

The first page reads: 'To gain a better understanding of the results of chrysanthemum cultivation as practiced today, and to make it easier to develop new varieties and to ensure that this process is channelled along more rational and artistic lines, the following questions must be answered, among others.' Fourteen questions and program points follow. Question 9: In which part of the plant is the flower's colour determined? Program point 14: 'It seems to me that in general the varieties of the chrysanthemum, like those of the rose, are *not* merely fashion products, but possess artistic significance of enduring value, and that they can be equated in all the most salient respects to inanimate objects – contrary to what H. de Vries maintains. Art experts at home and abroad should be consulted on this subject.'

If this was Willie's notebook, it reveals his passion for chrysanthemums. 'What was, or were, the original species?' He answers the question himself: 'The best way to find out would be by taking a trip to Japan.' Is too much manure damaging? Krelage and De Vries have proved that it is not. Poor cultivation makes flowers smaller. Does the good cultivation of varieties developed to produce the largest blooms make their blooms even larger, or is the size influenced only by the choice of sowing varieties? How do the most beautiful and the largest flowers come about?

Fundamental botanical research into the laws of heredity, as taught and conducted by De Vries, provided the foundations for the knowledge that Willie pursued. In his notebook he wrote, meticulously: 'How large is the number of variable single properties whose mutual combinations and permutations have produced and completely defined the varieties that have become known up to the present day?' Question 5: 'Is an excess of fertilizers such as zinc and iron absorbed or does the plant adhere to the normal maximum absorption?' Had Willie pursued and found the answers to these questions, he would at the very least have become a successful chrysanthemum grower – but he might equally have become a great connoisseur of art or a famous geneticist.[6]

The observations in this little notebook have never been mentioned before. Accounts of the origins of the Willie Commelin Scholten Phytopathology Laboratory generally say merely that Willie was interested in plant diseases, and that his parents therefore decided to establish a phytopathology laboratory after his death. But why phytopathology, actually, and not something else?

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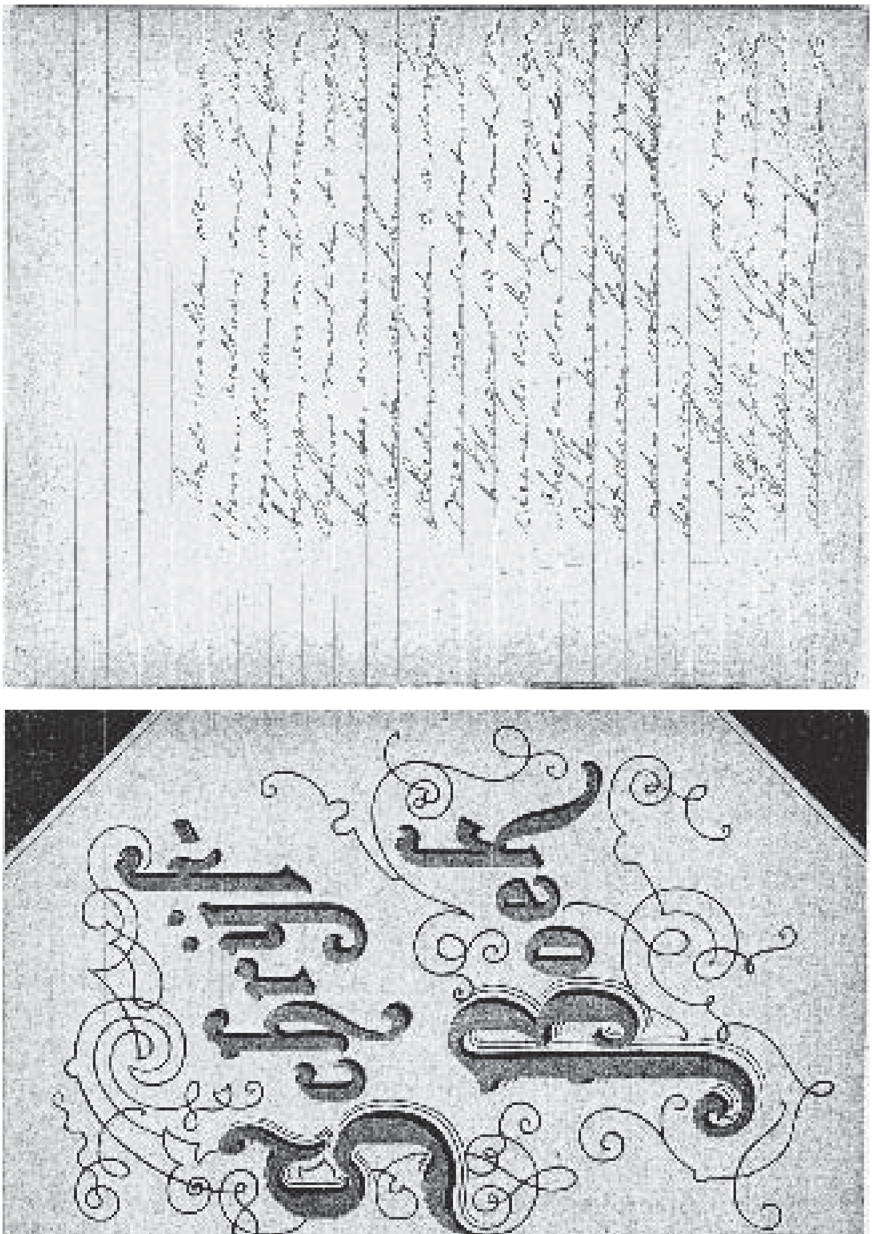
[6] Did Willie's special love of chrysanthemums somehow presage the rage for the genus in art? The Dutch artist Pieter Mondrian earned his living from 1900 to 1920 by making an estimated 200 portraits of chrysanthemums, in the form of drawings, watercolors and paintings.



Handwriting of Willie Commelin Scholten, c. 1892. Archives of the WCS, Haarlem.

Bulb trade and bulb-growing: Ernst Krelage

The oldest letter in the archives is dated 12 August 1893 – over a month after Willie's funeral. 'The large number of condolence letters we have received in response to the painful loss we have suffered with the death of our only son makes it impossible to answer them all separately', is the text printed within the heavy black mourning border. And written underneath, in wispy italics: 'Your letter gave us immense pleasure, because it showed so clearly that you learned to value our dear son for all his goodness and sincerity, qualities that were not always noticed because of his modesty. We seek our consolation here in the tranquillity of nature and expect to remain here until 3 September. Should you come to Amsterdam at some point after that, we would be highly gratified if you would pay us a visit. In our loneliness, it would be a blessing to speak again about our dear child, with someone for whom we know he felt great love and friendship.' The letter was addressed to Mr Ernst H. Krelage, Haarlem.

Ernst Krelage was Willie's friend. They were a little over a year apart in age, and both had attended Hugo de Vries's private seminars. They had met as members of the mathematics and physics debating society Naturae Exordia Vera Tradidit Omnibus Newton and the history debating society Clio Luce Investigamus Obscura.[7] Both were without siblings, and neither completed their studies; but there the comparisons end.

Ernst was the only son of the Haarlem bulb-grower Jacob Heinrich Krelage, a corpulent man with thick grey hair, a firm chin, and a resolute gaze. Ernst had started working in his father's business at 20 years of age. He continued to attend De Vries's lectures intermittently as an auditor, but did not take examinations. When the old Krelage died in 1901, Ernst followed in his footsteps, as his father had done after his own father's death.

Flower bulbs had been among the Netherlands' main trading products for centuries. At key moments, Jacob Heinrich loved to expound on how deeply the bulb trade was entrenched in the national consciousness. A discussion arose in the press at some point concerning the choice of a national flower, and Jacob was the first to insist on the tulip. His efforts were in vain, he was forced to acknowledge, disconsolately: 'Flowers and songs have little appeal to our nation's heart.'[8]

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7 'Nevton' ('Newton gave us all the true principles of nature') and Clio ('we explore the mysteries with Clio as light') were popular debating clubs. Krelage family archives, admission code 29-13, inv. no. 122: diplomas etc. from Commelin Scholten's student days are from GAH.

8 Character sketch of J.H. Krelage in *De Hollandsche Revue* II, ed. F. Netscher, 1897, vol. 2, no. 11, November 1897, p. 1.

It was the specific succession of peat and sand that made the soil between the dunes and the polder, between Haarlem and Leiden, ideal for bulb-growing. There, 'where the eternal murmur of the North Sea is heard',[9] a unique culture had evolved in the course of time, with its own laws and customs, its own rules and unwritten codes of conduct. In the latter half of the nineteenth century, bulb-growers had finally shaken off for good the terrible memories of tulip mania – 'when those charming flowers were degraded to the playing dice of a besotted population',[10] as Jacob Krelage put it. The bulb business was in the throes of a spectacular leap forwards. The bulb fields expanded from 300 hectares in 1860 to 600 hectares in 1880; and subsequently to 2500 hectares in 1900. Bulb exports, which had brought in only a million guilders in 1860, yielded three and a half million in 1890 and seven a half million around the turn of the century.[11] While the agriculture sector was languishing under the collapse of grain prices, the bulb fields flowered every spring in all the colours of the rainbow. It was a kingdom unto itself – and in that realm of bulbs, Jacob Heinrich Krelage was king.

Jacob's father, the first Ernst Krelage, had arrived there around 1800 as an 18-year-old, penniless farmer's son from Hanover, and had built up a prosperous life there. He had begun humbly, as a labourer doing the simplest farm work. He helped to dig channels, cleaned the sides of ditches, and mowed the grass. As time went on, he applied himself to bulb-growing. Unlike most of his contemporaries, however, he did not focus on cultivating particularly beautiful flowers for the wealthy elite, but on growing bulbs of an average standard, which were affordable for the fast-expanding middle classes. His horticulture business, founded in 1811, steadily expanded, mainly because Ernst took pleasure in developing new hyacinth varieties using cross-pollination and selection and offering them for sale at the flower exchange in Frankfurt am Main. By 1829, over 300 new varieties had been created using home-grown seed – not by the flowers and the bees, but by Ernst Krelage and his practiced eye. In 1850, Krelage was able to make his only child, Jacob Heinrich, co-proprietor of the firm that would henceforth be known as Ernst Heinrich Krelage & Son.

Jacob Heinrich, who was then 26 years old, also took the bulb business very seriously. By then Haarlem had become the heart of a bulb-growing region that stretched in a long band behind the dunes, parallel to the coast, from the

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[9] Ibid, p. 5.

[10] E.H. Krelage (ed.), *Gedenkboek ter herinnering aan het 50-jarig bestaan der Algemeene Vereeniging voor Bloembollencultuur te Haarlem 1860-1910*, Haarlem, Van de Erven Loosjes, 1910, p. 1.

[11] E.H. Krelage (ed.), *Gedenkboek ter herinnering aan het 50-jarig bestaan der Algemeene Vereeniging voor Bloembollencultuur te Haarlem 1860-1910*, Haarlem, Van de Erven Loosjes, 1910, Appendices.

northern to the southern Netherlands, and Jacob resolved to persuade the bulb-growers to join forces in a single organization. He succeeded in 1860, with the founding of the General Bulbgrowers' Association in Haarlem, although two of the elite bulb-growers' societies, 'The Bloom of Kennemerland' and 'The Flora of Noordwijk', declined to join. The Association grew in esteem with the appointment of several honorary members from the Royal House. Jacob Krelage himself naturally became President, remaining at his post for almost forty years.

The Association robustly championed the interests of the bulb-growing industry, 'which provides bread and even prosperity for many, besides fostering the love of … bulb-growing itself', in Jacob's words.[12] The primary objective was to mount an exhibition every five years, at which the most beautiful flowers would be crowned. Meanwhile, however, other matters also claimed its attention. Water levels, for instance. From 1872 onwards, the bulb-growers collectively bombarded the dyke reeve and polder board of the Rhineland with complaints about swamped bulb-fields. Seven years later they finally carried the day, winning a vote in decisions on the polder water level.

In 1874 the bulb-growers joined forces again, this time to do battle against rodents that were eating the leaves of bulbs in the dunes. They went on hunting expeditions that spring, decimating the populations of rabbits and hares – the Association's autumn assembly rang with applause. The following year, the executive committee wrote a bunch of angry letters to the government, asking it to urge the Italian government to scrap the ban on bulb imports, since the dreaded Colorado beetle only ate potatoes and not bulbs. In any case, the vermin would never thrive in the Netherlands' wet climate – or so it was believed. Not until 1888 did Italy decide to allow free imports again.

In 1879 the growers were busy promoting research into a mysterious disease that posed a threat to hyacinth cultivation. Jacob Krelage had asked fellow-townsman Hugo de Vries for advice, and De Vries rapidly performed some research in his own laboratory in Amsterdam, concluding that a bacterial infection might be to blame. Hearing this, the Association decided in 1883 to fund a long-term research project to be conducted by Jan Hendrik Wakker, one of De Vries's students, on the disease that was attacking hyacinths and other bulbs.[13]

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12 Ibid., p. 15.

13 See e.g. Hugo de Vries, *Knipsels en Herinneringen*, vol. III, October 1930, pp. 708-714, unpublished autobiography of De Vries, archives of Hugo de Vries, library of Anna's Hoeve Biology Centre, UVA; E.H. Krelage, 'Het onderzoek der hyacinthenziekten, een episode uit het prae-phytopathologische tijdvak', *Tijdschrift over Plantenziekten*, 1940, pp. 30-45.

Jacob Heinrich Krelage loved science. On his death in 1901, his house in Haarlem was found to contain the largest horticulture library in the country. He had collected and studied everything that had been written about bulbs and their cultivation. Not a single periodical had escaped his attention. As the years went by, he spent more time in his study than in the fields, but his business flourished as none other.

Even so, in 1885, when Wakker had been researching bulb diseases for three years, Krelage conceded that the findings were too meagre to be applied in practice. The young man's work was scientifically impeccable, but it elicited a disgruntled response from the Association's membership. What was the point of identifying the precise organism that was causing the slimy hyacinth disease? What was the point of learning all about its life cycle, if the findings did not point to a way of destroying it? All this research was just costing money; it might well bankrupt the Association.

Wakker acknowledged the problem. But the majority of plant diseases are caused by creatures that intrude into the body of the plant, he reported in the last of his reports. Once they have embarked on their destructive work within the plant, they cannot be reached, and 'the popular remedies that are used to powder the leaves, add to the soil, or spray into the air can no longer help.'[14] The only thing that might work in the battle against plant disease, perhaps, was some preventive remedy, but would the development of such a remedy justify the necessary time and expense? And would it meet expectations?

'What should we envisage as the practical goal of the research into a plant disease?'[15] Was it the survival of an individual, as in human pathology, or the survival of a species, or of a variety? It was a rhetorical question: anyone would surely concede that ultimately, what really mattered was preserving the species. And what remedies could help the species or variety to fight off the parasite? You had to choose: you could either try to exterminate the parasite, or gamble on procedures that would make the plant as strong as possible, including tried and tested formulas for a good harvest such as efficient fertilization, the effective selection of seeds, crop rotation, ensuring adequate soil drainage, efficient irrigation, and so on.

That was precisely what Willie had been working on, Krelage explained. Not curing disease, but preventing it – better still: actually improving the bulb yield! What a fine objective this could be for a new foundation: to launch a laboratory for varieties to be used in bulb-growing. This was a field

[14] J.H. Wakker, *Onderzoek der ziekten van hyacinthen en andere bol- en knolgewassen gedurende de jaren 1883, 1884, en 1885*. Haarlem, Algemeene Vereeniging voor Bloembollenkultuur, vol. III, p. 40.
[15] Ibid.

of self-evident importance – or so it certainly appeared to Jacob and Ernst Krelage themselves. Of all the branches of horticulture in the Netherlands, bulb-growing was the largest, and what is more – as all would surely agree – it was also the most important, renowned, progressive and (inasmuch as one could say such a thing) the most scientific of its kind.

In his characteristically delicate handwriting, Ernst Krelage Junior quoted his friend Willie as having said: 'It is a great pity that we know so little about the origins of most of the hybrids and varieties among our garden plants. It would be not only interesting but also instructive if we knew the entire genealogy of our Begonias, for instance; unfortunately, we know precious little about it. In general, we can say that there are very few rules involved in cross-pollination and that most of it is empirical.'[16] Jacob Krelage and his son were in no doubt: what Willie would have wanted was to create a laboratory for varieties to be used in bulb-growing.

Research on plant diseases: Hugo de Vries

'Yesterday evening we visited Professor Hugo de Vries, with whom we worked out the plans we had discussed with you. He endorsed your idea and is very willing to discuss this matter further … If possible, he would consider it more appropriate if the plans could be implemented in the grounds behind the house. Since he is less well-informed, however, about the space that we possess there now, after last year's expansion [i.e. the new conservatory], he plans to come and inspect the situation at 10 o'clock on Sunday morning. The Professor would be extremely pleased if you could be present on that occasion so that he may discuss certain matters with you.'[17]

It was the end of November 1893. The idea of founding a research institute dedicated to Willie's memory had become a firm plan in his parents' minds. It was time to get down to business.

A few days after the meeting, Hugo de Vries recorded his reactions to it. 'Among the institutions that Krelage mentioned last Sunday as qualifying for consideration to implement your idea, should the creation of a laboratory for varieties in Heemstede prove impracticable, the most promising one seemed to me a laboratory for plant diseases.'[18] So Krelage had proposed the idea of plant diseases, although he was not the only one to do so. But De Vries was thrilled.

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16 Ernst Krelage to Scholten, 23 November 1893, archives of the WCS.
17 Scholten to Ernst Krelage, 22 November 1893, archives of the WCS.
18 Hugo de Vries to Scholten, 29 November 1893, archives of the WCS.

Hugo de Vries, c. 1895. Library of the Biology Centre, University of Amsterdam

'I immediately saw the connection between this subject and the great passion with which your son tackled this subject too, at my laboratory. It was in the last winter that he worked with me.' Willie had asked De Vries for some samples of diseased plants. De Vries had responded by writing to Jan Ritzema Bos at the National College of Agriculture in Wageningen, who helped to procure a generous consignment of parts of plants that had been attacked by disease. Willie had learned a great deal from studying them. 'You will undoubtedly find the results of these studies among Willie's notes.'

And he clarified his train of thought: 'On further reflection, the idea of establishing a laboratory for plant pathology seems to me to be entirely true to the spirit of your son. He said on many an occasion that his passion was not the pursuit of pure science but the importance of scientific research to practical applications. And nowhere does botanical research yield such direct and such useful practical applications as in the field of plant pathology.'

Had Willie really expressed himself to this effect so frequently? Or was De Vries not primarily echoing his own doctrine here? De Vries continued: 'Admittedly, Willy's chrysanthemum studies were not directly related to the study of plant diseases …. but neither were they related to questions regarding the origins of varieties.' This latter point was easy to prove, he said. 'It is most obvious from his choice of this genus, and was also clear to me from the discussions we had on this subject. The production of varieties is based almost entirely on harvesting seeds and sowing them; in our part of the world, however, chrysanthemums do not produce any seeds, not even in greenhouses.'

Was De Vries familiar with the list of questions in Willie's brown notebook? Question number 10 reads: 'What is the easiest way to encourage chrysanthemums to produce seed in our climate? One could try the method that De Vries has used with other plants, that of leaving the cut flowers in carafes of water; the seeds tended to be quite small, but ripe and germinable nonetheless.'

In support of his proposal, De Vries wrote: 'I am not putting this forward to challenge Krelage's idea, which still has my warm support in spite of the difficulties involved, but merely because I am convinced that the idea of founding a laboratory of plant pathology would accord with your son's spirit just as well.'

Hugo de Vries – tall and thin-faced, with piercing eyes and a scrawny beard – was a man with a mission. He was born in 1848, the year in which the Constitution put an end to the king's authority, and the Netherlands' system of government took its first cautious steps towards democratization. With the rumbling of European revolutions in the background, Hugo grew up in the imperturbable tranquillity of Haarlem.

Like Willie, he was born into a prominent family. His father, Gerrit, had studied law in Leiden and had set up business as a lawyer in Haarlem in 1840. When Hugo was two years old, his father became a member of Holland's provincial council, and he later joined the Provincial Executive. In the 1870s, Gerrit de Vries rose to the position of justice minister in a government he had formed himself. Hugo's mother, the daughter of C.J.C. Reuvens, professor of archaeology at Leiden University, was highly conscious of her social status. As respectable members of the Mennonite community, they also felt a burden of responsibility for the world around them.

Hugo was a clever, serious boy, who started picking all kinds of plants and flowers in the fields and taking them home with him at a very early age. But he did not know how to preserve them. Through his father's connections, he made the acquaintance of Professor C.A.J.A. Oudemans, then professor of botany at the Athenaeum Illustre, who taught him how to make a herbarium. By 1860, when he started attending gymnasium (secondary school with classics) he had collected so diligently that his herbarium, with a hundred plants, received an honourable mention by the Society of Agriculture.[19]

After gymnasium Hugo de Vries studied botany at Leiden University. There he read Darwin's *On the Origin of Species*, which made a deep impression on him. The concept that species are subject to variation determined not only his scientific views but also his ideas about society. Those who understood the laws according to which species are formed would be capable of cultivating new, stronger crops at will, and possessed the key to social progress. 'Knowledge is power: may that power be used for the good everywhere and at all times', wrote the young academic, with heartfelt conviction.[20]

After Leiden, De Vries continued his studies in Germany, working under Julius Sachs at the University of Würzburg, Germany – which was then the academic heart of experimental botany. He became a skilled experimentalist, something entirely new in the world of natural history.

In the mid-1880s, by which time De Vries had been appointed first part-time professor (1878) and then full professor (1881) of plant physiology at the University of Amsterdam, he launched a series of experiments designed to determine the laws of genetic variation. In the early 1890s he believed that he was close to uncovering the secret of variability. Although it was not until

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[19] E.J.A. Zevenhuizen, *De Wereld van Hugo de Vries: De inventarissen van het archief van Hugo de Vries en van de andere archieven en collecties van de Bibliotheek Biologisch Centrum*, UVA, 1996, p. 17.

[20] See e.g. B. Theunissen, *'Nut en nog eens nut': Wetenschapsbeelden van Nederlandse natuuronderzoekers 1800-1900,* Hilversum, Verloren, 2000, pp. 125-148, esp. p. 141; B. Theunissen, 'Knowledge is power: Hugo de Vries on Science, Heredity and Social Progress', *British Journal for the History of Science*, 1994, pp. 291-311.

the dawn of the new century that he finally published his *Mutationstheorie* (Mutation Theory),[21] he was already convinced before then that he had discovered a ground-breaking supplement to Darwin's masterpiece.

At the heart of his theory were what he called 'pangenes' (later abbreviated to 'genes'), the carriers of each individual's characteristics. If a new pangene came into being, a new characteristic was born. The formation of species relied on 'progressive mutations' – that is, the creation of new pangenes. With the quantity of new characteristics, and therefore also the greater external and genetic differentiation, new species were the next step in the evolutionary process from simple to more complex life forms. Selection – the concept that was central to Darwin's theory of evolution – was of only secondary importance to De Vries. Selection did not generate new species; it merely determined which ones could survive. Mutations were the driving force behind evolution.[22]

But how mutations came into existence De Vries could not yet fathom. That was the next step in the academic process. Once this hurdle had been overcome, new species could be created at will, independent of chance. And that was the objective of science: eventually to return to practical application in a form 'in which it can be applied directly.'[23] De Vries was an idealist – no revolutionary, in spite of occasional sallies into revolutionary rhetoric. 'New races and new species! This will henceforth be the rallying cry, first for science and then for its applications, for the flowering of agriculture and the prosperity of nations!'[24]

The *Mutation Theory* made him world-famous, although its popularity was gradually smothered by the constant flow of criticism from home and abroad. De Vries was honoured with accolades and distinctions, tributes and busts, honorary memberships and invitations – being permitted to visit him was a favour much appreciated, and a signed portrait of him a coveted souvenir.

For a short period of time, De Vries was ranked among the world's great biologists: he inspired Thomas Hunt Morgan (1933 Nobel Prizewinner) to perform his research on heredity in the fruit fly, and corresponded with Jacques Loeb – like De Vries, a former student of Julius Sachs – who would later become known as the first biotechnologist *avant la lettre*. When the daily newspaper *De Nieuwe Amsterdammer* asked its readers in 1916 to compile a list of the

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21 De Vries, *Mutationstheorie*, 1901-03; published in English as *The Mutation Theory* in 1909-10.

22 Based on Zevenhuizen 1996.

23 Hugo de Vries, 'Wetenschap in dienst der praktijk', *Landbouwkundig Tijdschrift* 9, 1893, no. 4, pp. 217-230, esp. p. 230.

24 Theunissen 2000, pp. 125-148, esp. p. 135.

ten most important Dutchmen in the past fifty years, De Vries came fourth, after Thorbecke, Jozef Israëls, and Multatuli.[25]

'Krelage consistently urged academics to collaborate with those working in the field', wrote De Vries in his autobiography towards the end of his life, and the same applied to De Vries himself. Agriculturalists and horticulturalists saw him as the absolute scientific authority in their field, because of the constant stream of articles he published in their trade journals.

Whether Jacob Krelage and Hugo de Vries were acquainted while De Vries was living in Haarlem is uncertain. One thing is clear, however: De Vries's marriage to Krelage's cousin Louise Egeling in 1869 created a family relationship between them. After that, the two families strengthened their mutual ties in various ways. For instance, the young Ernst Krelage was invited to stay with 'Uncle Hugo and Aunt Wies' in Amsterdam for a few weeks in preparation for starting his university career there, and 'Uncle Hugo' paid tribute to his Haarlem connections by naming one of his sons 'Ernst.'

The ties between the two families were also beneficial in other, more businesslike ways. When Jacob Krelage founded the Scientific Committee of the Dutch Society of Horticulture and Botany in 1889, he asked De Vries to become a member, and in 1891, De Vries in turn asked Krelage to chair the executive committee of the Netherlands Phytopathological Society that he had recently founded.

It seems to have been typical of De Vries to seek, through acquaintances and students, to expand, protect – or at times to partition – his scientific empire. He himself was keenly interested in research on varieties, around 1890; so why should he not protect that area of research, and encourage others to study plant pathology instead?

'Your foundation is virtually guaranteed to succeed, with the right choice of director', he assured the Scholten family.[26] 'A laboratory of this kind would fill a gap that is universally felt as such in this country … particularly in recent years. Our Phytopathological Society, for instance, would immediately applaud it … as a step towards the realization of its aspirations. The foundation could count on universal support and cooperation; a laboratory for plant pathology could move straight to the vanguard of this entire field. It would soon, if not immediately, become the centre to which all related questions on matters of agriculture and horticulture throughout the country would be addressed.'

De Vries was now well into his stride: 'Choosing Amsterdam as the foundation's headquarters would be highly advantageous, partly because it is a

[25] Ibid., p. 146.
[26] Hugo de Vries to Scholten, 29 November 1983, archives of the WCS.

central location that is easy to reach from most parts of the country, and from which, conversely, its director will easily be able to visit nurseries if there is a serious outbreak of disease. Another advantage is the proximity of the city's libraries and laboratories, which have a treasure-store of aids to offer … Finally, foreign specialists will be interested in visiting the foundation when they come to attend exhibitions, conferences and so forth, and will spread its name abroad, which will be bound to boost the success of any educational courses. The more I think about this idea, the more it seems to me the ideal way of fulfilling your purpose.'

Scholten was powerless in the face of this onslaught. He immediately forwarded De Vries's letter to Krelage. 'In the final few months before Willie became ill, he spent a great deal of time with Professor De Vries, so that he is best placed to decide which direction Willie would have wanted to pursue', he wrote in an accompanying note.[27] What is more, De Vries favoured setting up the new foundation in the grounds behind Willie's parental home, so that everything that had been purchased and built for Willie's studies could be reused. 'That is what we would prefer', Willie's father concurred.

Ernst Krelage replied by return of post. 'I hasten to write in response to the letter from Professor De Vries that was sent to me for my perusal, for which many thanks.'[28] 'The Professor's idea of establishing a phytopathological laboratory can naturally count on my full support. I can imagine that you and he favour the foundation acquiring premises behind your house, and in these circumstances the Professor's plan is certainly to be preferred, since it can be implemented on your grounds and since it is *just as much* in Willie's spirit (I would not say *more so*) as the plan proposed by myself.' The words italicized here are heavily underlined.

'The idea of a phytopathological laboratory had occurred to me, too, and my father, as President of the Phytopathological Society, would certainly have been the first to applaud it.' But in proposing his own plan, continued the younger Krelage, his father had proceeded on the assumption 'that he should discount institutions that would be established sooner or later by the government.'

The Phytopathological Society had urged the government, as soon as it was established, to make funds available for a phytopathological institution. Jacob Krelage believed that these funds would be forthcoming in the longer term, and did not consider it appropriate for a private individual to relieve the government of its obligations. 'But if you do not regard this as an objection (which

27 Scholten to Krelage, 29 November 1893, archives of the WCS.
28 Krelage to Scholten, 29 November 1893, archives of the WCS.

is of course a matter of personal opinion), I have no hesitation in endorsing the professor's plan, since it would be no less important in terms of practical applications than my own.' The die was cast.

Twenty-eight years later, Ernst Krelage publicly questioned De Vries's good intentions for the first time. 'My father and I had suggested founding an institute for research on heredity', he wrote in 1921.[29] 'That was in 1893. The rediscovery of Mendel [i.e. Mendel's Laws] was not until 1900, and it could not be foreseen in 1893 that the question of heredity would soon come to play such a dominant role that the State itself would open an institute for it.' Where plant diseases were concerned, quite the opposite applied, which was why this had not been their first choice.

'My proposal was passed on to Professor Hugo de Vries for his appraisal, and he immediately dismissed it on the basis that no suitable director could be found for a research institute on heredity. Since a phytopathological laboratory also fulfilled the requirements, I resigned myself to this plan. … The effort to establish a relationship with the University of Amsterdam, where Willie C.S. had studied, was bolstered by the hope that Professor Hugo de Vries would be a powerful source of support for the foundation. You noted in your own letter how briefly Professor De Vries served as chairman.'

Hugo de Vries chaired the executive committee of the Willie Commelin Scholten Phytopathology Laboratory for exactly five years. In that period he completed his proof for the mutation theory. In 1899 he wrote that he needed more time for his scientific work, and resigned. In 1901 he published the first volume of his *Mutation Theory*, placing Mendel's Laws once again in the limelight of the science community.

Remarkably, while De Vries's unpublished memoirs contain detailed discussions of matters such as phytopathology, yellow disease in hyacinths, the General Bulbgrowers' Association, and his relations with the Krelage family, they say not a word about the laboratory that was established almost entirely at his insistence.[30]

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[29] Ernst Krelage to F.A.F.C. Went, 5 February 1921, IIAV, archives of Westerdijk, no. 5.

[30] Hugo de Vries, *Knipsels en Herinneringen*, vols. I-III, unpublished autobiography of De Vries, archives of Hugo de Vries, library of Anna's Hoeve Biology Centre, UVA.

2 Phytopathology: a private or a public institute?

Like farmhouses and land, the knowledge of farming was passed down from father to son. Farmers knew from experience which soil was more fertile and which fertilizer produced a higher yield. They had learned which crop rotation systems prevented soil exhaustion and reduced the risk of disease. They reproduced this knowledge for generation after generation. Improvements and innovations were ascribable to their own acute powers of observation and to chance rather than to the application of any insights based on scientific discoveries.[1]

Someone like Jacob Krelage, who farmed his land well, could afford to build a study and pore over scholarly treatises. Those with less money to spare continued to rely on timeless common sense [which the Dutch call *boerenverstand*, 'farmers' sense'– transl.], crop rotation, avoiding infected soil, removing diseased plants (or parts of plants) as quickly as possible, using healthy specimens for their further cultivation, good water management, sufficient fertilizer. The meagre provision of agriculture education was a luxury, and agriculture research even more so.

This situation changed dramatically towards the end of the nineteenth century. The change was precipitated first and foremost by the enormous crisis in agriculture into which European agriculture was plunged by the dumping of cheap grain from the United States, vast cargoes of which had been imported since the advent of ocean-going steamers. Germany and France closed their borders to the cheap grain in response, and the Dutch government appointed a special commission to study the problem. In its conclusions, in 1886, the commission asserted that government has a role in the development of agriculture. The Hague would have to abandon its outmoded *laissez-faire* policies and provide incentives for agriculture: it should set up research stations as well

[1] Such discoveries were few and far between; agriculture research was a marginal field in the nineteenth-century Netherlands and was primarily organized by enlightened farmers and Church ministers. See J. Bieleman, *Geschiedenis van de landbouw in Nederland 1500-1950*, Meppel Amsterdam, Boom, 1992.

as an agriculture and horticulture information service, and provide for adequate education and research in agriculture.

At the same time, the pressing threat of disease compelled European governments to take action. Besides passengers, crews and crops, the gigantic ocean steamers also carried pathogens. If these tiny stowaways landed in areas with favourable habitats and none of their natural enemies, they could multiply and spread unchecked, colonizing the new continent as true conquerors, with no regard for national borders and disdaining the desperation of farmers, the fury of landowners and the power of politicians. By the mid-century, the fungus *Phytophthora infestans* had already exhibited its ravages in the form of potato blight, disrupting entire societies and causing millions of people from Ireland to flee their country. Around 1880, minute insects such as the colorado beetle (in the United States) and the aphid *Phylloxera vastatrix* (in Europe) had completely disrupted transatlantic relations and had sown hostility between the countries of Europe.

In an effort to check the advance of *Phylloxera vastatrix*, the governments of a number of wine-growing countries in Europe had concluded the 1878 Bern Convention, an international convention attaching strict conditions to the trade in plants among the signatories.[2] The convention infuriated Dutch bulb-growers, who immediately saw their bulb exports plummet. 'What did the Gentlemen assembled in Bern know about *Phylloxera*?', snorted the farmers. 'They know nothing about insects or botany; otherwise they would have known that *Phylloxera* cannot survive on any other tree or plant [besides vines]. The provisions [of the Bern Convention] are equivalent to a measure introducing a ban on exporting fish in a country afflicted by cattle plague.'[3]

Scientific knowledge of plant diseases and the way they spread was needed to restore stability – but who possessed such knowledge? Whose task was it to organize it? Was it a matter for the government or for private initiative?

A private initiative

Jan Ritzema Bos was born in Groningen in 1850 as the second of three sons. His father was headmaster of a school for the deaf and dumb, and the boys learned a sense of duty, humility and a love of nature from an early age. Given their life histories, all three were evidently blessed with a good set of brains and a healthy dose of ambition, enabling them to better themselves through study and hard work: the youngest, H. Bos, studied biology, after which he and

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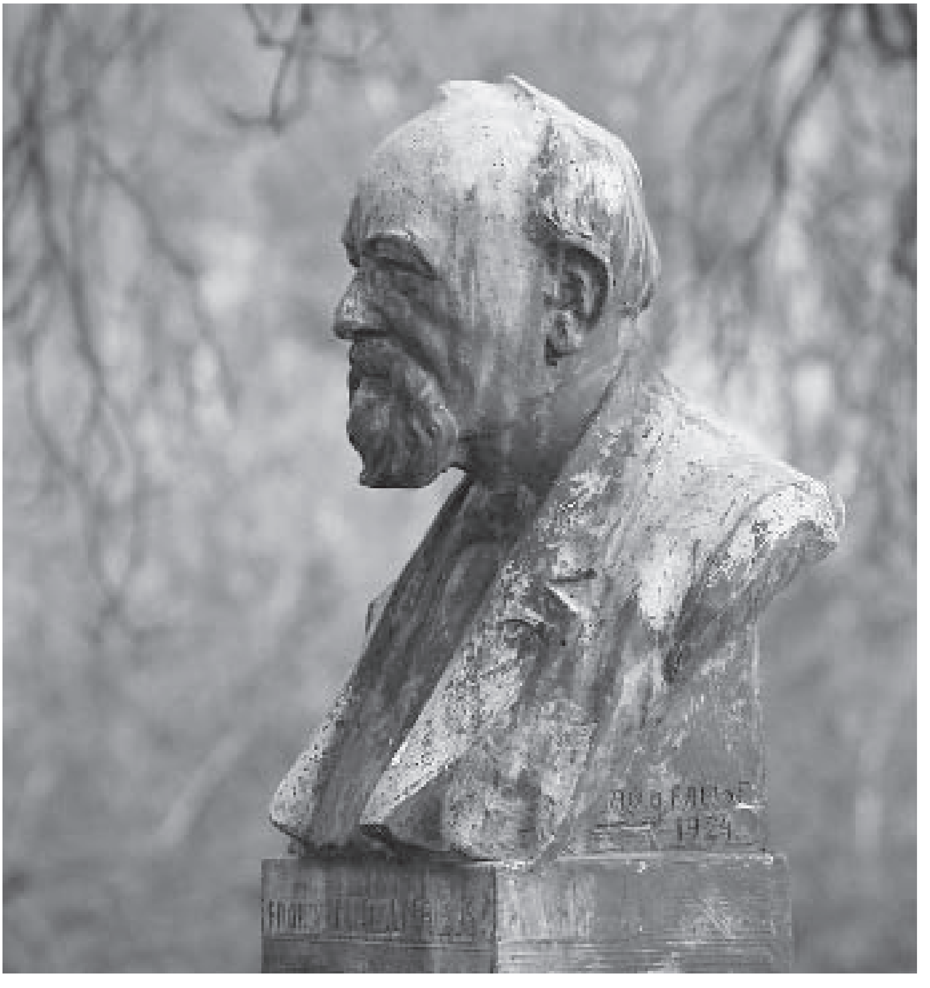
[2] See also *Semper Virens*, the horticulture weekly in the Netherlands, the organ of the KNTML, vols. 1875-1880.

[3] *Semper Virens*, 29 May 1880, pp. 171-172.

Ernst Krelage edited the horticulture journal *Tijdschrift voor Tuinbouw*, first published in 1894,[4] and Jan's elder brother Pieter Roelf became a secondary school geography teacher. It was this brother who, in token of gratitude for the opportunities he had been given, honoured the family name of Bos by attaching it in perpetuity to the school atlas he compiled: the Bos Atlas is still a standard item on every Dutch secondary school booklist today.



Bust of Jan Ritzema Bos. Agricultural University, Wageningen.

[4] The editors also included A. Ide, B.A. Plemper van Balen and Leonard A. Springer – the editors of *Vragen van den Dag*, a popular science periodical, referred to Dr. H. Bos as 'a well-known botanist'; see H. Blink, 'Prof. Dr. J. Ritzema Bos, de grondlegger der phytopathologie in Nederland,' *Vragen van den Dag*, 1920, p. 4.

Jan himself also studied biology at the University of Groningen, but he soon found that his interests lay elsewhere. The abstract treatises discussed in the physiology classes, plant taxonomy and anatomy all left him cold. It was not until the lectures on rural economy that Jan's interest was truly aroused, when Professor Herman van Hall explained the relationship between the productivity of different agricultural soils and the different tillage methods. He realized then that what fascinated him was not the life of a plant, but what the farmer did with it; not the creatures themselves, but their effect on the harvest. At some point during his studies in Groningen, Ritzema Bos evidently decided to use his knowledge of biology for the benefit of agriculture. That he became a teacher after graduating was the first, logical step in this direction.

His career as a teacher at the HBS (modern grammar school or Higher Burgher School) with agriculture in Groningen was short-lived (1869-1871). In 1870, the centre of agriculture education appeared set to shift to Warffum, where the famous German agriculturalist Dr Otto Pitsch had taken up a teaching position, and Ritzema Bos decided to move too, accepting a post in the three-year agriculture course that had just been started at Warffum's HBS. But when a similar course was launched in Wageningen, in 1873, and Otto Pitsch moved from the rural setting of Warffum to the almost equally rural Wageningen, Ritzema Bos too left the surroundings of his parental home and accepted a post at the HBS with agriculture – the School of Agriculture – in Wageningen. The school in Warffum subsequently foundered for lack of staff, just as the school in Groningen had been compelled to close its doors when the one in Warffum had opened. Agriculture education was still a luxury at this stage.

Not until the school opened in Wageningen did agriculture education finally begin to flourish, partly as a result of the government package of information, education and research measures. In 1876, the State assumed responsibility for it; the result was a State School of Agriculture with a fairly low admission threshold, where everyone who had completed three years of HBS secondary schooling could enrol to study for two or three years in one of the six available branches of study.[5] One reorganization after another ensued, and in just under

[5] 1. Dutch agriculture; 2. Colonial agriculture; 3. Dutch silviculture; 4. Colonial silviculture; 5. Agricultural chemistry and technology; and 6. Horticulture. Students staying on for a fourth year could specialize in one of sixteen fields: political economics; mathematics and mechanical engineering; surveying and levelling; interior design; draughtsmanship; physics, chemistry and meteorology; agricultural technology; mineralogy and geography; general and specific botany and zoology; anatomy and biology of plants and animals; morphology, breeds and diseases and the medical science and treatment of domestic animals; general and specific agriculture, horticulture and silviculture; cattle breeding, poultry, beekeeping and dairy farming; agricultural bookkeeping; the study of the agriculture, horticulture and silviculture industries; colonial agriculture and silviculture. See NA 2.11.35 – inv. 108: 'directie van de agriculture, afdeling agricultureonderwijs 1895-1957'.

forty years the Netherlands had its first and only college of agriculture – maturing many years later into a University of Agriculture.

Once he had settled in at the school in Wageningen, Ritzema Bos increasingly applied himself to plant pathology – or rather, 'plant damage', as he preferred to call it, after the German term *Pflanzenschädigung*. The struggle for life goes on everywhere, all the time, he wrote in 1881.[6] Tiny creatures vie with larger animals and with each other for the same food. Those who do not eat are either eaten or starve; that is how nature works. 'Only he deserves freedom and life itself who has to conquer them anew every day,' he quoted Goethe, approvingly: the fight must be fought with the eye and the hand, and only those who win it are worthy of producing a good yield.[7]

A farmer who wanted to survive had no choice but to immerse himself in that struggle. In Ritzema Bos's view, he would have to buckle under – literally to lower himself. Only someone who bent over a single potato plant and examined the underside of a potato leaf could see that the real 'culprit' was lurking there.

'Send me the diseased parts of your plants,' he invited farmers in the wider region. 'I shall examine them and advise you, free of charge, on the nature of the disease and the means of fighting it.'[8] According to his students, the farmers were always happy to see him, that young teacher who walked about like a real Sherlock Holmes, 'armed with a magnifying-glass, who could look at a leaf or root and identify the cause of many diseases. Gone was the farmers' old notion that town people obviously knew nothing about the growth of plants, and gone was their tendency to shake their heads over every unintelligible term from botany and zoology. Instead, they watched admiringly as one by one, the factors causing disease in the plants they were cultivating were revealed.'[9]

Like a modern Church minister, Ritzema Bos bombarded the farmers with words of advice: if an insect is only attacking a single crop, prevent a plague by using crop rotation. His logic could not be faulted. If the females of the pests only reproduce in the morning, before climbing the stalks of the plants, catch the pregnant females before they start climbing. His recommendations were practical and easy to apply. Don't shoot birds willy-nilly; they may be the

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6 J. Ritzema Bos, 'De strijd van de plantenteler tegen zijne vijanden uit het dierenrijk', n.p., unpaginated, 8 October 1881.

7 'Nur der verdient sich Freiheit wie das Leben, der täglich Sie erobern muss' are Faust's last words before his death; quoted by Ritzema Bos, see previous note.

8 See also J. Ritzema Bos, 'De Nederlandsche Phytopathologische (Plantenziektenkundige) Vereeniging 1891-1916,' *Tijdschrift over Plantenziekten,* 1916, pp. 54-83.

9 H. Blink, 'Prof. Dr. J. Ritzema Bos, de grondlegger der phytopathologie in Nederland,' *Vragen van den Dag*, 1920, p. 4.

natural enemies of your pests. Punish boys who catch bats or steal eggs from the nests of birds of prey; divert their energies by paying them a guilder or two for every hectolitre of cockchafers they can catch. Then feed those dead beetles to the pigs, or the chickens, or use them to make fertilizer. It's the same lesson every time: eat – or be eaten.

To help the farmers in their struggle, Ritzema Bos wrote textbooks, which he prepared for them and with them. 'Reader!' he urged: 'Write to me about your experiences, in different parts of our country and on different soils! It is of the utmost importance.'[10]

His output of textbooks is impressive. Five years after gaining his PhD, in 1874, with a dissertation on the '*Crustacea hedriophthalmata*' of the Netherlands, Ritzema Bos published the first volume of his textbook on pests and beneficial creatures in agriculture, *Landbouwdierkunde. Nuttige en schadelijke dieren van Nederland*, at the age of twenty-nine. Volume 2 appeared in 1882. A year later he published a book on insect pests, *Insectenschade op bouw- en weiland*, followed a year later by a textbook of zoology, *Leerboek der dierkunde*, the first edition of which appeared in 1884, and the 15th, posthumously, in 1939. In between times he also published several other books on related themes: *De dierlijke parasieten van den mensch en de huisdieren* (1888); *Ziekten en beschadigingen der landbouwgewassen* (four volumes, 5 editions); *Ziekten en beschadigingen der ooftbomen* (four volumes); *Ziekten en beschadigingen der kultuurgewassen* (two volumes). They are all easy to use; books that readers with little education could pore over at the kitchen table in the evening, or in extreme cases standing in the mud, looking at individual crops to discover what might be wrong and how it could be remedied.

Besides producing these books, Ritzema Bos studied numerous specific diseases and infestations. At the request of Jacob Krelage and the General Bulbgrowers' Association, he launched a study of the narcissus bulb fly and methods of controlling its population at the beginning of 1880. He exchanged experiences with Jan Hendrik Wakker, who was researching yellow disease in hyacinths at the same time and at the request of the same organization.[11] Once he had been admitted to this select gentlemen's club, new initiatives soon followed.

Again at the invitation of Jacob Krelage, and this time collaborating with Hugo de Vries and several of the country's other leading botanists, he joined the Scientific Committee of the Dutch Society of Horticulture and Botany in 1889.[12] In 1890 he and Hugo de Vries visited the International Congress of

[10] J. Ritzema Bos, 'Aardappelschurft en hare bestrijding', *Tijdschrift over Plantenziekten*, 1924, pp. 12-13.

[11] The relevant correspondence can be found in the library of the KAVB, Hillegom.

[12] This Committee was formed at the instigation of Jacob Krelage, the idea being to promote the mutual exchange of ideas and information between scientists and farmers. Members of the Society could send the Committee specimens of striking anomalies in their crops and ask for its expert opinion. They could also request advice on plant diseases.

Agriculture and Forestry in Vienna, where both immediately joined the International Phytopathology Commission that was set up there. A national equivalent soon followed – the Netherlands Phytopathological Society was founded in 1891, and it was again Jacob Krelage who became its first chairman.

The Netherlands Phytopathological Society set itself two initial objectives: 1. By conducting research and finding ways of controlling the diseases and pests attacking plant species under cultivation, to help Dutch agriculture, horticulture and silviculture to flourish; 2. To appoint experts or to prepare the ground for experimental stations for phytopathology.[13] The Scholtens' plans, just two years after the Netherlands Phytopathological Society had been founded, happened to fit the second of these objectives perfectly.

Hugo de Vries probably approached Ritzema Bos at the beginning of 1894 to find out whether he was interested in becoming the director of a new phytopathology laboratory. At the time, the government too was considering plans for setting up an institute of this kind. The State School of Agriculture in Wageningen was undergoing reorganization, after which it would have its own laboratory of plant diseases at the end of 1894, led by Ritzema Bos. This position was the logical next step in his career.

Whether Hugo de Vries knew about these plans is not known.[14] It seems likely that he did, given his interests and his network, but on the other hand, the Municipal University of Amsterdam, in the country's capital city, and the State School of Agriculture in the rural town of Wageningen had very little in common. Ritzema Bos, on the other hand, was well aware of the plans; as was Jacob Krelage.

The archives do not contain the original of his letter, but the reply from The Hague has been preserved. On 6 February 1894, F.B. Löhnis, the Inspector of Secondary Education in charge of supervising agricultural schools, wrote: 'If the institution you envisage is established, it would be highly objectionable to set up something similar in Wageningen, since this would dissipate resources, which would not benefit the cause.' Löhnis himself had designed the reorganization of the State School of Agriculture that was in progress.[15] 'I would greatly regret the departure of Dr Ritzema Bos from Wageningen, and in the interests of the State School of Agriculture I shall certainly do everything within my power to keep him there.'

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[13] J. Ritzema Bos, 'De Nederlandsche Phytopathologische (Plantenziektenkundige) Vereeniging', *Tijdschrift over Plantenziekten*, 1916, p. 65.

[14] The library of the KAVB in Hillegom contains the correspondence between J.H. Krelage and H. de Vries. De Vries does not mention this subject in his letters.

[15] Löhnis to Krelage, 6 February 1894, archives of the WCS.

'There you have it!' Krelage must have thought. 'Why should we do something with private capital that the government is already planning to do with public funds?' But De Vries – who was immediately informed of the content of this letter by Scholten – did not share Löhnis's fear of dissipating resources. 'In my view, this country has room for four or five phytopathology laboratories,' he wrote to Scholten,[16] adding, 'though a sensible division of labour is greatly to be desired.' Wageningen could concern itself with direct, practical work, such as identifying causes of disease, and looking up the answers in manuals. An institute in a university city could conduct far more detailed research into obscure or unknown diseases. This would take longer, but more than one disease could be studied at a time. 'While this research would be of less benefit in the short term, in the longer term it would carry more weight.'

Ritzema Bos agreed. To Krelage he wrote: 'In my humble opinion, the intended Foundation should indeed be set up: first, because it is completely unclear whether the reorganization of the State School of Agriculture and the launch of a phytopathology laboratory there will actually happen, and if so, *when*; and second, because it is very doubtful whether the Government would ever tackle this material on the scale that Mr Scholten has in mind; and third, because I believe that Amsterdam is a better location for a phytopathology laboratory than Wageningen.'[17]

His letter is ten pages long. Its gist can be summarized in a few words: it would be far better for a phytopathology laboratory to be set up by private initiative than by the government, since one would have no patronizing rules to comply with and no other interests to take into account, and one would be free to do as one saw fit.

The best strategy, Ritzema Bos advised, would be simply to go ahead. 'If he [i.e. Löhnis] is presented with a *fait accompli*, he may be inclined to cooperate, to subsidise the institute in Amsterdam by paying for an assistant (which does not actually seem to me an absolute necessity at the beginning), by providing an annual sum for travel and accommodation expenses, or by awarding a grant for the publication of a phytopathology journal or bulletins. … In my view, if we do not seize the generous opportunity that lies before us, nothing will happen for many years comparable to what Mr and Mrs Scholten have in mind.'

[16] De Vries to Scholten, 1 March 1894, archives of the WCS.
[17] Ritzema Bos to Krelage, 13 March 1894, archives of the WCS.

Just how much influence the decision to establish the Willie Commelin Scholten Phytopathology Laboratory had is hard to say in retrospect. But the planned reorganization of the State School of Agriculture was in fact scrapped – at least, it did not take place until 1896. In March 1894, Ritzema Bos wrote to Scholten that he would be 'delighted' to accept Scholten's offer, 'in particular because of your willingness to remove my primary objection by assuring me of a pension … I hope to do my best to ensure that the capital invested in your Foundation is well spent.'[18]

'I am pleased that we beat Mr Löhnis and secured you for the directorship of our Foundation,' wrote Scholten, relieved.[19] 'No competition is to be expected from the government.' On 18 December 1894, in Amsterdam, the notary signed with an elegant flourish the deed establishing the Foundation that was to be called, as laid down in Article 1, 'the Willie Commelin Scholten Phytopathology Laboratory'.

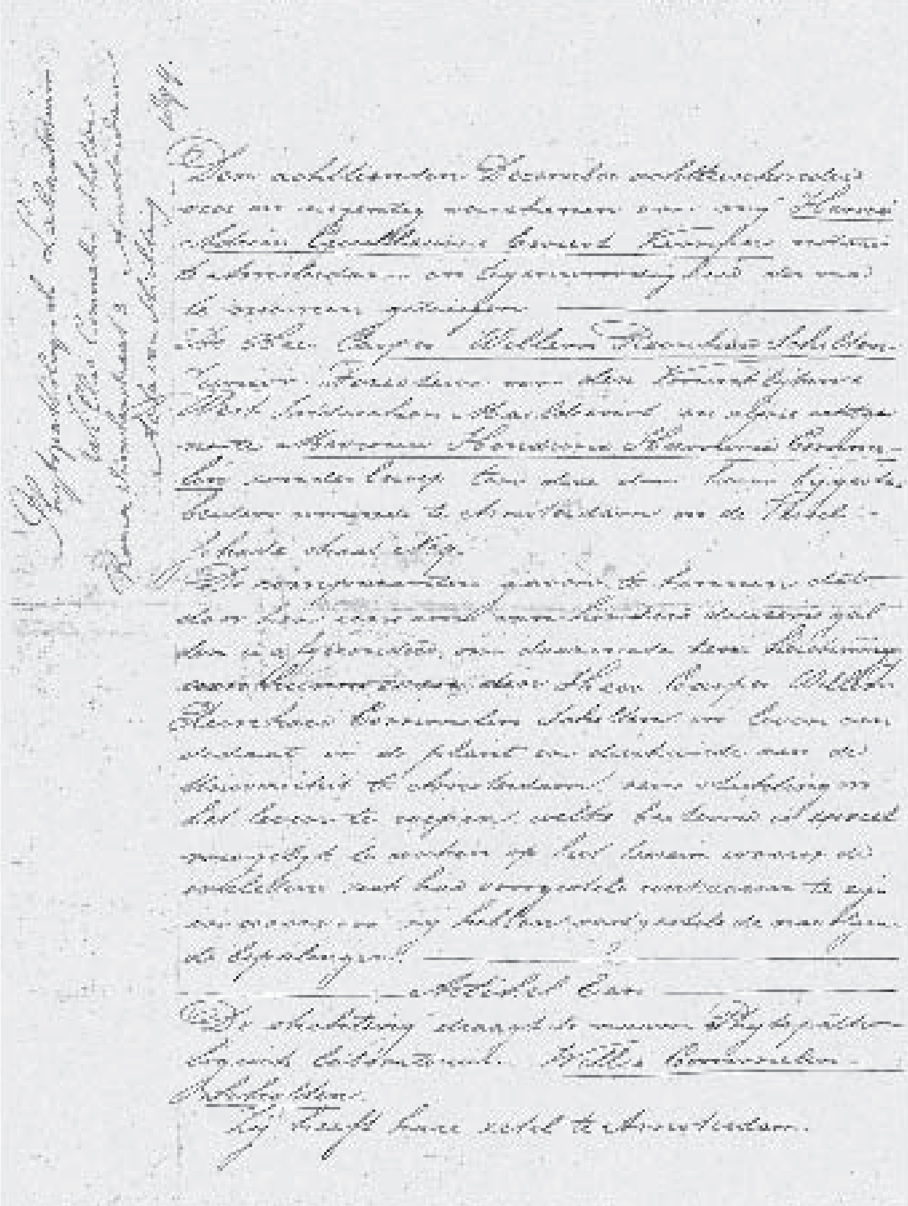
Article 2 reads: 'The objective of the Foundation is to conduct research into the causes of diseases affecting plants under cultivation and the damage done to these plants by animal pests, and on remedies for the control of these diseases and this damage. To this end, the Foundation will make its services available for the following: providing information to agriculturalists, horticulturalists and silviculturalists about the sources of diseases and damage to their crops, as well as informing them about ways of preventing and controlling these diseases and this damage; adding to the knowledge of plant diseases and pests by conducting research; and promoting the interests of botany and zoology education at the University of Amsterdam and the interests of phytopathology education in general.'

Ritzema Bos declared triumphantly that the Netherlands now ranked among the first countries in Europe to possess an institute of this kind.[20] As a member of the International Phytopathology Commission, he knew that several other European countries (including France, Germany, Austria and Switzerland) had by then heeded the Commission's advice to all the 'civilized countries of Europe' to set up institutes of phytopathology. He also knew what initiatives had been taken, and that these diverged considerably in form and content.

[18] Ritzema Bos to Scholten, 24 March 1894, archives of the WCS.

[19] Scholten to Ritzema Bos, 19 April 1894, archives of the WCS.

[20] J. Ritzema Bos, 'Mitteilungen der Internationalen Phytopathologischen Kommission', *Zeitschrift für Pflanzenkrankheiten, Organ für die Gesamtinteressen des Pflanzenschützes unter Mitwerkung der internationalen phytopathologischen Kommission*, 1895, p. 65.



Title page of the deed establishing the Willie Commelin Scholten Phytopathology Laboratory. Archives of the WCS, Haarlem.

In Germany, for instance, existing institutes had been expanded,[21] while in Switzerland a central institute started to take shape in 1893.[22] In Paris, the agriculture minister had promulgated a decree on 24 August 1888 that would eventually lead to the founding of a phytopathology laboratory. And the Belgian Botany Society had appointed a phytopathology committee in 1894 *inter alia* to develop the necessary statistics in this field.[23] Ritzema Bos felt that change was in the air, and it was only a question of time before similar organizations would be springing up in the other countries of Europe and governments would readily be lending their support.[24]

On Monday 4 February 1895, at the Scholten family home, Ritzema Bos was officially appointed director of the new laboratory. Almost the entire board of governors attended: Ernst Krelage (the youngest, at twenty-six), Hugo de Vries (chairman of the board), F.B. Löhnis (on behalf of agriculture education), and Mr Scholten. Jacob Krelage from Haarlem and Professor Julius MacLeod from Ghent were also present as special guests. MacLeod presided over the Society of Natural Sciences Dodonaea in Ghent, and offered to publish the new journal of plant pathology (*Tijdschrift over Plantenziekten*) jointly with the Foundation, starting in April 1895. It was an offer that the board of governors and the newly-appointed director eagerly accepted.

The only empty chair was that of Mrs Scholten, the fifth member of the board. Her state of mind was darkened by memories and grief, which were undermining her health.[25] She felt too weak to attend. Ritzema Bos said that

[21] For instance, in 1894 the former institute of plant physiology attached to Berlin's agriculture college was renamed the Institut für Pflanzenfysiologie und Pflanzenschutz (Institute of plant physiology and plant protection), and a similar change of name was announced in Halle: see P. Sorauer, 'Mitteilungen der Internationalen Phytopathologischen Kommission', *Zeitschrift für Pflanzenkrankheiten, Organ für die Gesamtinteressen des Pflanzenschützes unter Mitwerkung der internationalen phytopathologischen Kommission,* 1894, pp. 65-66; 'Die ursprünglich zur Unterstützung des Rübenbaues bestimmte Station in Halle [führt jetzt] die Bezeignung "Versuchsstation für Nematodenvertilgung und Pflanzenschutz".'

[22] P. Sorauer, 'Mitteilungen der Internationalen Phytopathologischen Kommission: Die Bewegung auf phytopathologischem Gebiete in der Schweiz', *Zeitschrift für Pflanzenkrankheiten, Organ für die Gesamtinteressen des Pflanzenschutzes unter Mitwerkung der internationalen phytopathologischen Kommission* 1893, pp. 321-322.

[23] P. Sorauer, 'Mitteilungen der Internationalen Phytopathologischen Kommission', *Zeitschrift für Pflanzenkrankheiten, Organ für die Gesamtinteressen des Pflanzenschützes unter Mitwerkung der internationalen phytopathologischen Kommission* 1894, p. 193.

[24] Ibid., p. 193.

[25] See the correspondence between Ritzema Bos and Scholten of 5 December 1894 and 10 January 1895, archives of the WCS.

The Willie Commelin Scholten Phytopathology Laboratory, Roemer Visscherstraat, Amsterdam. Archives of the WCS, Haarlem.

he greatly regretted her absence, 'but I fully appreciate that it is better for her to stay away.'[26]

It was a bitterly cold day. The laboratory – a large mansion at Roemer Visscherstraat 1 to 3 in Amsterdam, which had only just been completed – stood empty but immaculately painted. The trees in the large garden poked their bare branches into the thin air. The ceremony itself was a simple affair. Only Hugo de Vries spoke a few suitable words.[27] The board members congratulated each other and the new director. He thanked them for the confidence they had vested in him. And then everyone went his own way.[28]

Not so long afterwards, appreciative responses started turning up at the Scholtens' house. The Former Pupils of the State School of Agriculture paid them a 'sincere tribute for your princely gift in the interests of science, and for the benefit of agriculture and horticulture students.'[29] Similar expressions of enthusiasm arrived from the Netherlands Phytopathological Society and the University of Amsterdam.

A service for agriculturalists

'The Willie Commelin Scholten Plant Damage Information Centre.' If it had been up to Ritzema Bos, that is what the new institution would have been called. The phrase 'experimental station' – De Vries's idea – struck him as ugly, besides which he thought it would conjure up in most people's minds an institute for the inspection of fertilizers and seeds.[30] The term 'laboratory' was acceptable, but 'information centre' fitted the institute's activities best. And 'phytopathology' was too narrow, since it did not include frost shake, sunburn, freezing or insect damage.[31] 'Plant damage' was the most appropriate term.

This debate about names reflects how greatly Hugo de Vries and Ritzema Bos disagreed about the content and definition of phytopathology – although neither was inclined to put his foot down at the time.

Shortly after his installation as director of the new Foundation, Ritzema Bos had gone to visit two fellow phytopathologists in France, on De Vries's advice.[32] On his return he reported enthusiastically on the Frenchmen's

[26] Ritzema Bos to Scholten, 27 January 1895, archives of the WCS.
[27] See J. Ritzema Bos, 'Het Phytopathologisch onderzoek in Nederland, en het Phytopathologisch Laboratorium Willie Commelin Scholten te Amsterdam', *Tijdschrift over Plantenziekten*, 1895, pp. 1-12.
[28] NWCS I, archives of the WCS.
[29] 'Vereeniging van oud-leerlingen der Rijkslandbouwschool' to Scholten, 14 February 1895, archives of the WCS.
[30] Ritzema Bos to Scholten, 16 and 20 April 1894, archives of the WCS.
[31] Ritzema Bos to Scholten, 16 April 1894, archives of the WCS.
[32] E. E. Prillieux and E. G. Delacroix.

wonderful collection of plant diseases caused by fungi and bacteria. Everything bottled in spirits was in splendid order. But Ritzema Bos had been struck by the lack of cooperation in France between scientists on the one hand, and agriculturalists and horticulturists on the other. To his astonishment, in that entire, vast country, the two full-time professors of phytopathology in Paris received fewer requests for information in a year than he dealt with alone – and until recently he had been responding to such queries on a voluntary basis. This was incomprehensible, given the diseases that had been afflicting viticulture for decades. No, he concluded dryly, 'the cooperation between theory and practice in Paris is not yet as it should be.'[33]

Nothing at all would change between himself and the farmers and horticulturalists, he assured readers in the first issue of *Tijdschrift over Plantenziekten*.[34] From the Phytopathology Laboratory he would continue, as in the past, to provide information to farmers, florists, vegetable-growers, amateur gardeners, fruit-growers and silviculturalists. This was, and would remain, the Laboratory's main task. If anything, there would be a change for the better. 'While in the past I sometimes had to keep my answers brief for lack of time, once I can devote myself entirely to the research on plant diseases and plant damage, as director of the Phytopathology Laboratory, I hope always to be able to provide information in as much detail as is needed.'[35]

Nor would much change for his students in Wageningen. He would still (at the school's request) be teaching several classes a week at the State School of Agriculture. For 'the cause of phytopathology' he would have to travel more than in the past, and besides, he argued to the board, keeping in touch with Wageningen could only benefit the laboratory in Amsterdam. Moreover, as a teacher in Wageningen he would have soil, laboratory equipment, books and journals at his disposal that he would not need to purchase in Amsterdam.[36] He hoped to have more time for research, but he had always accorded this element lower priority. And expectations in this regard should not be unduly high, he warned again, since 'sometimes years of prolonged, serious study are needed to identify the cause of some particular plant disease.'[37]

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33 Ritzema Bos to Scholten, 22 April 1895, archives of the WCS.

34 J. Ritzema Bos, 'Het Phytopathologisch onderzoek in Nederland, en het Phytopathologisch Laboratorium Willie Commelin Scholten te Amsterdam', *Tijdschrift over Plantenziekten*, 1895, pp. 1-12.

35 Ibid., p. 10.

36 Ritzema Bos to Scholten, 15 January 1895, archives of the WCS.

37 J. Ritzema Bos, 'Het Phytopathologisch onderzoek in Nederland en het Phytopathologisch Laboratorium Willie Commelin Scholten te Amsterdam', *Tijdschrift over Plantenziekten*, 1895, p. 11.

But however much Ritzema Bos may have tried to give farmers and horticulturalists the impression that the existing regime would be continued and intensified, in the event the change was dramatic. The geographical move, if nothing else, meant an abrupt break with the past.

Wageningen, around 1895, was a small, quiet little town, embedded in an endless expanse of empty land along the outskirts of the Veluwe area of natural beauty, with a vast stretch of marshland on one side, and the three main types of soil – sand, clay and peat – all within walking distance. For centuries, the rhythm of life there had been dictated by the passing of the seasons, the unyielding cycle of sowing and reaping. With much the same rigid regularity the people attended church on Sundays, and returned home to the safety of their hearthside before dusk.

Amsterdam, at the end of the nineteenth century, was a sparkling city, surrounded by meadows that were fast being dug over to build ostentatious hotels, and grand terminals for the big steamships navigating the river IJ. The city itself was alive with the transport of steel arches, piles to be driven into the ground, and scaffolding. The steaming and panting of construction machinery banished every trace of silence, as the city gradually spread over the surrounding lands like an oil slick.

What is more, Amsterdam was brimming with intellectual renewal in the precise district where the new Laboratory was to open its doors: the gleaming new Concertgebouw had just opened, and the cultural elite could now come and listen to the country's first professional orchestra, after which they could saunter around the neatly laid-out Vondelpark – the kind of nature the intelligentsia like best – in their coats and tails and top hats, or adjourn to the lounge of the brand-new Hotel Americain, where they could discuss the unstoppable march of progress or simply sit and listen to the sounds of the languages spoken by the foreign hotel guests. There too, unrest was brewing about the 'social question', and the controversial figure Aletta Jacobs was welcoming other fighters for women's suffrage – coincidentally right next-door to the Phytopathology Laboratory.

From rural backwater to refined bourgeoisie: it was a big leap. And although Ritzema Bos was not instantly expected to drink his tea with his little finger hovering at a dainty distance from his cup, the fact that phytopathology, a body of knowledge that until then had been passed on from one grower to the next in word and deed, was now a real part of the university curriculum, gave the subject's status an enormous boost. Like it or not, Ritzema Bos would have to learn to mix with professors and others from the higher echelons of society as well as farmers and horticulturalists.

On 27 June 1894, Hugo de Vries had suggested to Scholten that the title of professor be requested for Ritzema Bos personally. A link with the University of Amsterdam would enhance the Laboratory's status – besides, Willie himself would surely have backed the idea.[38] But better not reveal that he had proposed this idea himself, he added hastily, when his suggestion was taken up.[39] Instead, the request should appear to come from Scholten personally rather than from the board; not because of Krelage's antipathy to the university – a minor matter, apparently – but because his colleague Oudemans, professor of plant taxonomy at the University of Amsterdam, had not been consulted about the new Foundation. 'I respect the reasons for this, but you will understand that I am loath to sign this application, which impinges on his own field. If they assume that the idea is your own, it will not be offensive to him, and I can strongly support it, but if it is signed by me, the effect on him might be less pleasant.' De Vries was still chairing the faculty at the time, and in this capacity he would be in a position to make the appointment run smoothly, but not if it were to leak out that he had been personally involved: 'this would not be well received by my colleagues, in any case.'[40]

The plan was successful, and Amsterdam's municipal executive decided to appoint Ritzema Bos as extraordinary (that is, part-time) professor of plant pathology – an unsalaried position, it should be added. Ritzema Bos accepted the challenge. On 29 November 1895, having been 'called to the office of Extraordinary Professor of a science that has never before been taught as a separate subject at one of our institutions of higher education', he officially joined the academic staff of the University of Amsterdam.[41]

A modest number of students and other interested parties took their seats in the auditorium for this occasion, the *Telegraaf* daily newspaper reported the next day.[42] Only one or two authorities, including the Queen's Commissioner, showed their faces. 'A few ladies also came to hear the inaugural address', the reporter noted. But the professors turned out in force.

Under the stern gaze of the men clad in their black gowns seated in the front few rows, Ritzema Bos took his place at the lectern. For three-quarters of an hour he held forth on subjects ranging from fungi to beetles, from nematodes to clubroots, from aphids to mosquitoes and butterflies. An aspiring phytopathologist, he told his audience, was a farmer, scientist and physician rolled into one: he was at home in chemistry, physics, zoology and botany – he knew the main crops as if he had cultivated them himself – he knew the local

[38] De Vries to Scholten, 27 June 1894, archives of the WCS.

[39] De Vries to Scholten, 22 January 1895, archives of the WCS.

[40] De Vries to Scholten, 11 March 1895, archives of the WCS.

[41] J. Ritzema Bos, 'De ziektenleer der planten en hare beteekenis voor de praktijk en voor de beoefening der biologische wetenschappen', *Tijdschrift over Plantenziekten*, 1895, p. 121.

[42] *De Telegraaf*, 30 November 1895, IIAV, archives of Westerdijk, no. 79.

conditions under which they were grown, and which recommendations were practicable and which were not. Book learning was necessary and useful, he stressed, but it was not enough.

It took him several minutes to enumerate everything that belonged to the field of phytopathology. He then went on to say, 'I thus take the widest possible view of the pathology of plants, namely as the science that concerns itself with the study of all influences that impede the normal, healthy development of crops under cultivation or parts of these crops, and of the remedies that can be used to modify or eliminate these influences. Phytopathology is not an area of botany, but an independent applied science.'[43]

'Students!' he concluded 'For most of you, the subject I shall be teaching is beyond the sphere of your studies; and it is not compulsory for anyone. So I cannot expect that many of you will be among my students. … Not everyone has many talents. But everyone who has worked earnestly on his own development may later be a blessing to others…. I shall be happy to work with you, in the hope of advancing your knowledge and my own in the short term, and in the expectation that our efforts will not prove later to have been without benefit to society.'[44]

To all those listening, it was clear what to expect from their new professor. His teaching and research would be designed for practical application. The focus would be not on plants, but on plant diseases. If Hugo de Vries had cherished any vestige of hope that the new professorship – which he had so strongly promoted –[45] might contribute to his own work on heredity, this hope will have been extinguished in the forty-five minutes of Ritzema Bos's address. From this moment on, agriculture and horticulture, far more than scholarship and science, had acquired a feisty new champion.

Trojan horse

'I assume you have heard about Ritzema Bos's appointment as extraordinary professor of plant pathology?' Hugo de Vries enquired *en passant* of his most talented former pupil, Frits Went.[46] Went was preparing to sail from the East Indies, where he and Jan Hendrik Wakker had researched sugarcane diseases. Wakker had decided to remain in the East Indies for the time being, but Went

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43 J. Ritzema Bos, 'De ziektenleer der planten en hare beteekenis voor de praktijk en voor de beoefening der biologische wetenschappen', *Tijdschrift over Plantenziekten*, 1895, p. 124.

44 Ibid., pp. 121-152.

45 De Vries to Scholten, 27 June 1984; De Vries to Scholten, 22 January 1895; De Vries to Scholten, 11 March 1895, archives of the WCS.

46 De Vries to Went, 28 June 1895, archives of Hugo de Vries, MB, Leiden.

F.A.F.C. Went, c. 1920.

returned to the Netherlands, where he took up a chair in general botany at Utrecht University in 1896 – a career move that De Vries and his fifteen-years-younger protégé had carefully stage-managed while the latter was abroad.[47]

Went's return could not have come at a better time for De Vries. Leaving aside their appearance – De Vries was tall and thin, Went short and fat – they were very similar. Like De Vries, Went had been regarded in his student days as self-willed, gifted, ambitious and innovative. And like De Vries, Went too, once he had taken up his professorship, proved to be a brilliant *Realpolitiker* in the university senate, an inspiring teacher, and a superb organizer. Went's arrival meant that De Vries finally had an opportunity to withdraw to the seclusion of his laboratory with his evening primroses to immerse himself in the mysteries of evolution.

As Went started taking over most of De Vries's committee work, the Willie Commelin Scholten Phytopathology Laboratory was approaching its fifth anniversary.[48] The professors had agreed that De Vries would remain on the board until the annual meeting in February 1899, and take his leave a few weeks later. Then, De Vries predicted, efforts would doubtless be made to co-opt 'some well-known character with money' on to the board – and if possible to make him chairman. 'I myself would not think this a bad thing for the laboratory's financial interests. By the way, I believe the Foundation currently receives an annual grant of 7,000 guilders towards its budget.'[49]

This latter point was untrue: although such a sum had been mentioned, the conditions attached to its approval had not yet been stated. This matter was on the agenda of the fifth annual board meeting, the first to be attended by Went.

At 1.30 p.m. on 10 February 1899, Went ascended the steps of the Scholtens' mansion. All the members of the board except for De Vries were there. So was the director. Ritzema Bos had just returned from a study trip of six months in the United States, where, at the request of the Dutch Government, he had studied the habits, the dissemination and the danger of infection posed to the Netherlands by the San José scale insect (*Aspidiotus perniciosus*).[50] A few

[47] See the correspondence between the two men in the archives of Hugo de Vries, MB, Leiden.

[48] In consultation with De Vries, Went took over many of his administrative positions: besides replacing him on the board of the WCS, he also did so in the International Phytopathology Commission and on the board of the Netherlands Phytopathological Society. The Scientific Committee of the Dutch Society of Horticulture and Botany was disbanded on 21 March 1896 after the founding of the Willie Commelin Scholten Phytopathology Laboratory.

[49] De Vries to Went, 18 November 1898, archives of Went, MB, Leiden.

[50] The request was officially submitted by the Minister of the Interior, under whose auspices the Agriculture Department operated at the time; this department was run by Director-General C.J. Sickesz. Ritzema Bos had set off on his field trip at the urging of Jacob Krelage and Sickesz.

minuscule scale insects had been detected on some peaches from California a few months earlier, and the Dutch Government had responded by immediately closing its borders to imports of trees and shrubs from the United States, along with most other countries in Europe. But was this a rational decision?

To find out the answer, Ritzema Bos had spent two months travelling around several states of America. He had visited orchards and spoken to leading experts. He had read what biologists had discovered about the scale insect's habits, and had discussed and seen the various pesticides that had been tried out on it.

He had concluded that the San José scale insect was an extremely harmful pest for the fruit-growing sector. But it flourished, and caused most harm, in subtropical regions, and it would therefore be incapable of doing much mischief in the Netherlands. So from a phytopathological point of view, the import ban was unnecessary.

But there were other, political, considerations. If the Netherlands were to open up its borders – as the only country in Europe to do so – its trees would be subjected to the same ban as those from America. Better than having to keep a constant watch on each other's actions, the European countries would do best to ensure that each country had its own plant protection service, as in the United States.

That service would be responsible for certifying imports and exports of agricultural and horticultural produce, and tracking down diseases through national inspections or at the request of the farmers themselves. In principle, not an apple or a sprout should be able to leave a market without a certificate.[51] Ritzema Bos estimated that the costs of such a plant protection service would amount to 7,000 guilders. The most appropriate solution, he considered, was for it to operate under the auspices of the Willie Commelin Scholten Phytopathology Laboratory.

This was the main point on the agenda of the meeting held in February 1899: could the board agree to the conditions set by the government in awarding a 7,000-guilder grant to set up a plant protection service? Until then, the

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The Ministry of Agriculture and Fisheries was not founded until 1935; until then, Agriculture was a department within other ministries: initially the Interior, later Water Management, Trade and Industry. In 1937, however, it merged with the Ministry of Trade, Industry and Navigation to form the new Ministry of Economic Affairs. Agriculture did not acquire its own ministry again until after the Second World War, this time together with Fisheries and Food Supply. Today, the Netherlands has a Ministry of Agriculture, Nature and Food Quality.

[51] J. Ritzema Bos, 'De San José schildluis. Wat wij van haar te duchten hebben, en welke maatregelen met het oog daarop dienen te worden genomen', *Tijdschrift over Plantenziekten* 1899, pp. 33-127; pp. 145-167; *Tijdschrift over Plantenziekten* 1900, pp. 152-159.

government had given the Foundation an annual grant of 500 guilders, out of a total operational budget averaging 8,000 guilders. Half of this came from interest on the capital of 100,000 that had been deposited in 1894. The Scholtens made up the rest of the money needed in cash each year. The new grant would almost double the Laboratory's total budget. Would that mean that the government would want to be allowed an equal say in its activities?

Indeed it would, replied the Director-General of the Agriculture Department of the Ministry of the Interior, Mr C.J. Sickesz. He too attended this meeting, and proceeded to read out the conditions at the board's bidding. The grant was intended only for the plant protection service. The Ministry would determine the activities of the head of this service. The director of the Willie Commelin Scholten Phytopathology Laboratory would also serve as head of the plant protection service. The government wished to have a say in the appointment of other members of staff, and it also wanted two representatives on the board of the WCS Foundation. And to cap it all, Sickesz made it known that the government would not consent to Ritzema Bos's intention to appoint Miss Tine Tammes as his assistant, 'since this post would in due course mean serving as the Director's deputy, and he did not consider a lady suitable for such a position.'[52]

A brief silence must have ensued. The appointment of an assistant was deferred post-haste. For the rest, the minutes simply state: 'Mr Scholten proposes passing on Mr Sickesz's notes to Mr J.C. de Vries, who also drafted the deed establishing the Foundation. After this a meeting will swiftly be convened, at which the board will decide whether or not to accept the grant on the set conditions.'[53] A few weeks later the board communicated its acceptance, with the proviso that it would not permit two extra members to join its ranks, but only two representatives with an advisory vote.[54]

The work of the new Plant Protection Service would not change much in the laboratory's day-to-day routine, Ritzema Bos reassured a worried Went, who had by then taken over as chairman of the board. 'The main thrust of the Laboratory's work has always resided in practical applications. And the appointment of myself as director made it clear that this was indeed the intention; article 2 of the deed establishing the Foundation corroborates this, in that it first mentions providing information to growers, *then* research, and lastly education.'[55] The Director-General also saw no danger of a conflict of

[52] NWCS I, fifth meeting, 10 February 1899, archives of the WCS.
[53] NWCS I, fifth meeting, 10 February 1899, archives of the WCS.
[54] NWCS I, seventh meeting, 18 March 1899, archives of the WCS.
[55] Ritzema Bos to Went, 24 February 1899, IIAV, archives of Westerdijk, no. 2.

interests arising. He predicted that the main effect of the inspections – the Plant Protection Service's main task – would be to increase the number of samples sent in.[56] And this would also be to the Laboratory's advantage. Krelage too thought that the advent of a Plant Protection Service would in general be a good thing for the Laboratory. [57] Went, who was initially worried that the new service might claim too much time and attention at the expense of the Laboratory's work, found himself alone in this opinion and reluctantly resigned himself to the change.

Was it the money that clinched the decision? For Mr Scholten, the increased grant was an enormous relief. It seemed that The Hague had finally understood that cooperating was much better than competing, and that the private laboratory in Amsterdam was truly an institution to be taken seriously. And although the annual extension of the grant was not guaranteed, such solid government support would keep Willie Commelin Scholten in good stead for the time being.

'The men in the field' too reacted enthusiastically.[58] The editors of the horticulture journal *Tijdschrift voor Tuinbouw* marked the festive event by devoting its entire fourth volume to the Amsterdam couple who had founded the laboratory, 'the benefits of which can now, by virtue of the government's support, be far more wide-ranging than envisaged when it was founded.'[59] The journal's opening photograph shows the couple's faces: grave, proud, and full of grief.

Ritzema Bos viewed the change largely as a boost to his own authority. 'I have been serving *de facto* as head of the Plant Protection Service since last autumn', he mused, although the Service would not actually exist until 1 January 1900. It had been as State Phytopathologist that he had spoken to his American fellow-scientists; in fact he had made the entire trip in that capacity. 'It is only because Mr Sickesz has so many other matters to attend to that the statutory regulation of the Plant Protection Service has not yet been concluded.'[60]

Anticipating the busy times that lay ahead, Ritzema Bos took on Constant van Hall as his assistant in the autumn of 1899. Van Hall – who had been studying botany and zoology at the University of Amsterdam since 1893 – was working as Hugo de Vries's assistant at the time, and was probably appointed on his recommendation. But within eighteen months, the director and

[56] NWCS I, seventh meeting, 18 March 1899, archives of the WCS.

[57] Ibid.

[58] Words used by Ritzema Bos, e.g. in *Tijdschrift over Plantenziekten,* 1904 editorial.

[59] *Tijdschrift voor tuinbouw*, ed. H. Bos, A. Ide, E.H. Krelage, 1898.

[60] Ritzema Bos to Scholten, 24 May 1899, archives of the WCS.

Aan

DEN HEER EN MEVROUW C. W. R. SCHOLTEN-COMMELIN

WORDT DE VIERDE JAARGANG VAN HET

„TIJDSCHRIFT VOOR TUINBOUW"

OPGEDRAGEN DOOR DE

REDACTIE.

Mr and Mrs Commelin Scholten. *Tijdschrift voor Tuinbouw* Groningen, 1898. Library of the General Bulbgrowers' Association, Hillegom.

his assistant were embroiled in such a furious row that the entire board had to intervene, and the laboratory's very survival hung in the balance.

Only in retrospect can the Plant Protection Service be identified as the Trojan horse that led to this rift. Without it, Ritzema Bos could probably have waited far longer before appointing an assistant, so that no quarrel would have arisen; but that was not the reason for the ensuing breach. What narrowed the Laboratory's options was the government influence that came with the Service. The choice of Van Hall, who was of an impractical cast of mind, only accelerated the process that led inescapably, with the advent of the new Service, to a single, sharply-worded question: what was the objective of the Willie Commelin Scholten Phytopathology Laboratory: the pursuit of science or providing a service for agriculturalists?

A public concern

The row was triggered by an offer made in the summer of 1902 by Melchior Treub, the then director of the botanical gardens in Buitenzorg (now Bogor) on Java, in the Dutch East Indies. A few months earlier, Van Hall had been awarded a doctorate on the strength of his dissertation on bacterial plant diseases (*Bijdrage tot de kennis der bacteriële plantenziekten*). Treub happened to be staying briefly in the Netherlands, and asked Van Hall if he wanted to spend a few years researching the diseases of Java's Deli tobacco.

Van Hall had initially found it a tempting offer, he wrote to Scholten.[61] On second thoughts, he decided it was better to stay and to try and solve the problems he was having with the state of affairs at the Laboratory. He wrote a letter to Ritzema Bos, who was in Münster at the time, with two complaints: first, he objected to the increase in the number of letters he now had to write (105 in 20 days!), and second, he keenly felt the lack of an experimental greenhouse or garden. In passing he also referred to Treub's offer. Great was his consternation when Ritzema Bos wrote back that he would do well to accept Treub's offer, and that he could expect few changes in the near future.

Van Hall was at a loss to understand. Nothing had ever passed between the two men that suggested 'any unpleasantness', although he had occasionally felt slighted, he wrote to Scholten. But now he wanted to discuss the matter with Went as soon as possible. He could not do so without bringing up the 'conditions and abuses' at the Laboratory. He would say no more than necessary – the details were unedifying, and were in any case unimportant.

[61] Van Hall to Scholten, 20 August 1902, archives of the WCS.

But he felt obliged to speak out, since without experimental fields, the Laboratory was doomed. This was the gist of Van Hall's letter to Scholten on 29 August 1902.

What were these abuses about which Van Hall felt compelled to inform Went? From the few letters that passed between Van Hall, Went, Scholten and Ritzema Bos, two grievances can be distilled. The first was administrative: Van Hall wanted the budget to be divided meticulously into different items, so that it was clear at a glance how much had been spent on what, and when. He felt that Ritzema Bos had developed a mode of administration over the years that lacked transparency. Exchange journals: were they for the Laboratory or the director? The gas bill: what proportion was payable personally by the director and what proportion belonged to the Laboratory's expenses? Travel expenses: why did Ritzema Bos always declare more? And so on. The second grievance was more substantive, and arose partly from the first: Van Hall wanted to separate the Laboratory's different tasks. He proposed himself as head of a department of 'plant diseases caused by fungi', and Ritzema Bos – in line with his special field – as head of a department of 'plant diseases caused by animal pests.' This division would make his work easier and more pleasant, since 'given the major difference of opinion between Ritzema Bos and myself on *administrative* matters, a conflict is inevitable sooner or later if no such division is effected.'[62]

Scholten's position, at this point in the correspondence, is unclear. Went, on the other hand, thought that Van Hall's proposal was 'not a bad idea: it would simplify matters, reduce Ritzema Bos's workload, and release Van Hall from what he evidently finds to be a burden (constantly having to ask the director for this and that) … and I can see nothing to suggest that the director's authority would be undermined.'[63] He undertook to broach the idea to Ritzema Bos.

But the latter was infuriated.[64] To begin with, the director thought it strange that Van Hall had discussed the idea of partitioning the laboratory with Went and Scholten without ever having mentioned it to him. But this did not alter his position. Phytopathology, in his view, was an indivisible whole. Since the cause of a disease is never clear to begin with, samples could not possibly be divided up into botanical and entomological specimens when they came in. He, Ritzema Bos, did not wish to steer clear of research on mycology; nor should his assistant, Van Hall, eschew entomological work, since the two men should be able to replace one another.

[62] Van Hall to Scholten, 5 September 1902, [italics orig.], archives of the WCS.
[63] Went to Scholten, 5 September 1902, archives of the WCS.
[64] Ritzema Bos to Went, 6 September 1902, IIAV, archives of Westerdijk, no. 2.

'The Laboratory does not need one entomologist and one botanist (mycologist); it needs two phytopathologists.'[65]

This position was crucial, as reflected in the numerous issues of *Tijdschrift over Plantenziekten*, which had until then been filled almost entirely with Ritzema Bos's contributions. These showed how he felt the work should be done. First comes an accurate description of the symptoms, followed by the conditions in which they occur, then one must track down the cause, and the final stage is to consider possible remedies. Experiments are useful, but only to supplement this basic framework, and ever-mindful of the maxim that local conditions always differ from one place to the next and can greatly influence the course of a disease. 'Experiments involving intentional infection represent unnatural conditions, and their results are therefore not always valid', was the essence of a declaration of principles that Hugo de Vries and Ritzema Bos had signed together in 1897, as members of the International Phytopathology Commission – in retrospect the only international initiative to which Ritzema Bos attached any value, as he said himself.[66]

As long as one remained largely ignorant of a plant's 'predisposition' – a rather vague term that Ritzema Bos borrowed from the German professor and phytopathologist Paul Sorauer, whom he greatly admired – it was impossible to predict which plant would become sick and which would not, conditions being equal.[67]

As things stand, phytopathology is still largely an empirical science, held Ritzema Bos. It therefore belongs not in a laboratory but in the field. Only there can the phytopathologist see the crop with his own eyes, and only there may he notice details that are not visible in the unnatural surroundings of a laboratory. The possible causes of a disease are infinite, since the cultivation of a crop can be affected by an infinite number of factors. The volumes of the *Tijdschrift* were full of these details: is the plant in the middle of the pot?[68] Have children damaged the bark while climbing the tree?[69] Has the city council recently salted the roads?[70] Have the plants only recently

65 Ritzema Bos to Went, 6 September 1902, IIAV, archives of Westerdijk, no. 2.

66 See *Zeitschrift für Pflanzenkrankheiten* 1897; J. Ritzema Bos, ' De Nederlandsche Phytopathologische (Plantenziektenkundige) Vereeniging 1891-1916', *TP,* 1916, pp. 67-68.

67 J. Ritzema Bos, 'Belangrijke problemen der phytopathologie', *Tijdschrift over Plantenziekten,* 1903, pp. 147-149.

68 J. Ritzema Bos, 'Poot de planten midden in den bloempot', *Tijdschrift over Plantenziekten*, 1895, p. 12.

69 J. Ritzema Bos, 'Wonden, ontstaan door het klimmen in boomen', *Tijdschrift over Plantenziekten*, 1897, p. 68.

70 G. Staes, 'Invloed van zout op de boomen', *Tijdschrift over Plantenziekten*, 1895, p. 156; J. Ritzema Bos, 'Is het gewenscht, dat door de overheid toegestaan worde de ontdooiing van sneeuw met pekel op tramlijnen, waarlangs boomen staan?', *Tijdschrift over Plantenziekten,* 1898, p. 1.

been planted out?[71] Have temperatures been normal for the time of year?[72] Are the crops in the right soil? And so on and so forth. Conclusion: it is not possible to specialize within the field of phytopathology, since every case is different. Creating two separate departments was out of the question, and that was the end of it.

Ritzema Bos's answer is detailed and unequivocal, as usual. But in this dispute he soon descended into malice, and dwelt on Van Hall's shortcomings as one reason for his refusal to split the laboratory into two departments. 'During the first few years Dr V.H. gave me little assistance, because he was ignorant of agriculture and horticulture and had no time to remedy his lack of practical knowledge, since he had to study for his exams. This situation is improving now – but I would not be happy to leave the providing of information to growers to him on a permanent basis, where mycological matters are concerned.'[73]

But agriculturists had been very pleased with Van Hall's recommendations, talks and general demeanour, wrote back a flabbergasted Went, who was by then constantly being prompted in the background by Scholten and Van Hall.[74] The board (Löhnis too had sided with the majority view) would greatly regret Van Hall's departure. 'Are you willing to sacrifice Van Hall to your objections?'[75]

Of course Van Hall was now a very valuable asset, Ritzema Bos replied immediately, in a seven-page letter. But it went without saying that he was not yet sufficiently familiar with the various agricultural crops that he could be entrusted with making recommendations concerning samples. His letters still had to be read and checked, and the two men often discussed cases before he answered them, 'so that a large proportion of the letters written and signed by him are not exclusively his work.'[76]

Ritzema Bos continued to insist that practical considerations made it impossible for him to countenance two departments. In this context he implicitly gave himself and his own approach a pat on the back.

Van Hall's departure would indeed be regrettable, but mainly 'because we would have to start from scratch training somebody new, who would again

71 J. Ritzema Bos, 'Hoe komt het, dat soms jonge plantjes na 't verpoten zoo slecht vooruit willen?', *Tijdschrift over Plantenziekten*, 1895, p. 120; J. Ritzema Bos, 'Over het aanbinden van pas geplante boomen', *Tijdschrift over Plantenziekten*, 1900, p. 45.

72 J. Ritzema Bos, 'Gele randen aan de bladeren van kruisbessen, tengevolge van de lage temperatuur van 't voorjaar', *Tijdschrift over Plantenziekten*, 1901, p. 24.

73 Ritzema Bos to Went, 6 September 1902, IIAV, archives of Westerdijk, no. 2.

74 Scholten to Went, 8 September 1902, IIAV, archives of Westerdijk, no. 2.

75 Went to Ritzema Bos, 12 September 1902, IIAV, archives of Westerdijk, no. 2.

76 Ritzema Bos to Went, 14 September 1902, IIAV, archives of Westerdijk, no. 2.

be of little use in the beginning, as was initially the case with V.H. It would be several years before he had reached the same stage. … In the few years of its existence, our institution has established a reputation in the world of agriculturalists, landowners and growers. That is certainly not the work of Van Hall …. If the Phytopathology Laboratory is to maintain its standing among agriculturalists, the work must continue in the same vein as before. And to this end I consider it necessary that I myself should remain in charge, to continue calm and collected along the chosen path.'[77]

According to Ritzema Bos, the Willie Commelin Scholten Phytopathology Laboratory had made itself indispensable among agriculturalists, landowners and growers. The samples sent in, which served as the gauge of demand and which were therefore recorded by the director with painstaking precision, continued to increase in number each year: from 354 in 1895 to 667 in 1898, and 975 in 1901.[78] In the record year of 1902, the Laboratory received as many as 1,169 letters. It was quite inappropriate to complain about the number of letters to be written, observed Ritzema Bos scornfully. Does a farmer complain about a good harvest?

As for experimental fields: 'V.H. allows himself to be led too much by brief impressions. Certain experiments were launched on his initiative, in which he displayed great diligence; whether this diligence will endure if they fail to produce any results of scientific value in the first few years remains to be seen; I feel there is good reason to doubt it.'[79]

No, the future was to be a continuation of the past. 'As director, I shall therefore never give my approval to splitting up the institution into departments. It would be infinitely preferable to bid farewell to Van Hall.'

The conflict rapidly escalated. Van Hall immediately informed the other board members – after all, Treub's offer would not last forever. One by one, the board members decided whom to support. Löhnis, the board's representative from the Department of Agriculture, had a long discussion with Ritzema Bos after which he endorsed the latter's line of argument. The problems arise from the poor relationship between the two men, he wrote to Went. Van Hall should have more respect for Ritzema Bos's qualities.[80] It was time for the board to have a serious discussion of this matter of principle.

Went circulated a memorandum convening a board meeting at the earliest opportunity.[81] Ritzema Bos was too busy to concern himself with it. 'It is

77 Ibid.

78 Annual reports of the Willie Commelin Scholten Phytopathology Laboratory for 1895 to 1904.

89 Ritzema Bos to Went, 14 September 1902, IIAV, archives of Westerdijk, no. 2.

80 Löhnis to Went, 19 September 1902, IIAV, archives of Westerdijk, no. 2.

81 Went to Scholten, 22 September 1902, archives of the WCS.

obvious to me that Prof. R.B.'s intention is to delay matters to such an extent that my letter will still be unanswered when I have to make my decision', Van Hall complained to Went.[82]

'Ritzema Bos informed me that the idea [of the two departments] is *wholly unacceptable* to him', Van Hall wrote to Went a few days later.[83] 'Even if the Board voted for it, he would not accept the decision. My point is this: Will Prof. R.B. threaten to resign if he hears that the board has voted in favour of it? I suspect he will. At the time I told Prof. R.B. that if this were truly the case, I would seriously consider giving up my position as assistant at the Phytopathology Laboratory, which was true at the time. Now my mood has changed, however, and I am inclined not to run away.'

'Van Hall has decided to accept Treub's offer', Ritzema Bos informed Went two days later.[84] 'The meeting is no longer necessary … But since the matter has been raised, you may still feel that a board meeting is desirable nonetheless.' He added a few possible dates for this eventuality.

'I have reason to believe that Van Hall has not in fact expressed himself so decisively', Scholten wrote to Went after this.[85] 'It seems to me that Mr R. Bos is trying to postpone the meeting in definitely. I consider it of the greatest importance that the meeting be held as soon as possible.'

Meanwhile, Went had heard from Van Hall that 'Lovink [the new Director-General of the Agriculture Department] considered the question an internal dispute between assistant and director, and he even thought that I had been wrong to involve the board in it.'[86] 'In fact, in his view the board is not even competent to decide on this matter.'

At the same time, Ritzema Bos was writing to Went: 'First Van Hall told me that he would accept the position offered by Dr Treub.'[87] So then the meeting became unnecessary. Later on, Van Hall said that he was in fact very reluctant to leave, and that he would therefore not insist on his demands. 'Now the most essential thing is that *all* the board members attend the meeting, especially since you have circulated Van Hall's letter – with his proposal for a split – without giving myself as director an opportunity to add my own recommendation.'

Ritzema Bos's generally neat italic handwriting now developed jagged strokes of fury. 'And why did this proposal not reach me before? As director, I should

82 Van Hall to Went, 24 September 1902, IIAV, archives of Westerdijk, no. 2.
83 Van Hall to Went, 27 September 1902, IIAV, archives of Westerdijk, no. 2, italics orig.
84 Ritzema Bos to Went, 29 September 1902, IIAV, archives of Westerdijk, no. 2.
85 Scholten to Went, 30 September 1902, IIAV, archives of Westerdijk, no. 2.
86 Van Hall to Went, 3 October 1902, IIAV, archives of Westerdijk, no. 2.
87 Ritzema Bos to Went, 3 October 1902, IIAV, archives of Westerdijk, no. 2.

have received it far earlier. And since, according to the deed establishing the Foundation, I am the secretary of the board, it is up to me to convene the next meeting. I shall ask the Scholtens, as well as Messrs Tijdeman, Lovink and Krelage, if they can meet on Saturday 11 October – Mr Löhnis has already informed me that this day would be convenient.'

'I think it better to leave this letter unanswered', Went wrote to Scholten, enclosing the letter from Ritzema Bos.[88] 'For if such crass accusations are hurled at me, I would be obliged to answer in very crass terms myself – also given the impertinent ending of the letter. And then I could no longer keep my seat on the board while Ritzema Bos remains director. And the goal pursued by the Foundation is too close to my heart for me to leave the board, especially now that I think that there is a chance that the Foundation may attain that goal, if someone like Van Hall is attached to it. I have never been particularly struck by Ritzema Bos's exertions to this end.'

Went was finally able to inform Ritzema Bos: 'I received a letter from Dr C.J.J. van Hall, addressed to the board, making it known that he withdraws his proposals as a result of a discussion with you, and that now that most of his wishes have been met, he has turned down Mr Treub's offer.'[89] Director and assistant had agreed to draft a budget together, which would henceforth be administered by Van Hall.

But Went felt compelled to add a final word. 'I did not answer your letter of 3 October, because its tone was such that I would have been unable to reply other than in extremely crass terms. I suspected that in a mood of resentment, perhaps, you had seen fit to write me such a letter, accusing me of a lack of veracity and making other insinuations. I trust that upon calm reflection, you will see that the tone of your letter was improper.'

Two phytopathology institutes

Van Hall did eventually leave after all. At the beginning of 1903, he accepted a position as inspector of agriculture in Suriname, on Went's recommendation and through his mediation, and at the beginning of 1904 he also became director of the Agricultural Experimental Research Station. As his next assistant Ritzema Bos appointed Hendrik Quanjer, another former student of Hugo de Vries's, to start on 1 May 1904. But the administrative 'inaccuracies' at the Laboratory continued to be a thorn in the side of the board, especially to Scholten and Went.

88 Went to Scholten, 4 October 1902, archives of the WCS.
89 Went to Ritzema Bos, 7 October 1902, IIAV, archives of Westerdijk, no. 2.

For several years, Ritzema Bos tried 'with meticulous precision to avoid any appearance of an improper use of funds.'[90] He purchased a second cupboard, in which he stored the fuel for the Laboratory (the first cupboard contained the fuel for the residential part of the building).[91] He separated the books in the library that were his own from those belonging to the Laboratory. From then on, those wanting to borrow a book for any time were required to sign a receipt.[92] He accounted for every cent of the gas bill. Yet the mistrust persisted, in spite of a number of 'good talks' and lengthy letters. 'It must pain you to experience unpleasantness in the laboratory built for your son', wrote Ritzema Bos.[93]

In his final years as director, the laboratory was still being sent large numbers of samples, but the 1902 record was never challenged. With 876 samples, 1903 was a quiet year, but that had to do with the weather. In 1904 the number of samples received rose again to 1,157.

The teaching side of Ritzema Bos's activities was ailing, however. The number of students attending his courses at the university had fallen dramatically. 'Professor Ritzema Bos lectured on and off for ten years', wrote students in their 'Comments on Lectures of the University of Amsterdam.'[94] 'Attendance (biology and pharmacy students) tended to be quite high at the beginning of the year, but much smaller by the end. This was more a consequence of his teaching style than of any lack of interest in phytopathology.'

In October 1903, confidential talks were launched in Wageningen on the need to reorganize the State School of Agriculture.[95] They were attended by Ritzema Bos, as director of the Willie Commelin Scholten Phytopathology Laboratory, and the two government representatives who sat on the board of the WCS in an advisory capacity, Löhnis and Lovink. The agreed aim was to elevate part of the State School of Agriculture to an institute of higher education, by means of a complicated restructuring operation. On 4 March 1904 this plan was debated in parliament, and on 10 August 1904, Queen Wilhelmina signed Royal Decree no. 29:

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90 Ritzema Bos to Scholten, 9 January 1904, archives of the WCS.

91 Ibid.

92 Ritzema Bos to Scholten, 25 January 1904, archives of the WCS.

93 Ritzema Bos to Scholten, 7 April 1903, archives of the WCS.

94 'Commentaren op Colleges aan de Universiteit van Amsterdam'; see *Almanak van het Amsterdamsch Studentencorps*, 1907 (concerning 1905-1906).

95 NA, 2.11.35, 'Directie van de Landbouw, afdeling landbouwonderwijs 1898-1957', inv. 149, minutes of meetings of 26 October 1903, 4 November 1903, 14 November 1903.

‘We, Wilhelmina, by the grace of God Queen of the Netherlands, Princess of Orange-Nassau, etc., etc., etc., on the recommendation of Our Minister of Water Management, Trade and Industry of 5 August 1904, no. 6577, Department of Agriculture, have approved and understood:
A.I. as from 1 September 1904, that the School of Agriculture, School of Horticulture, and the Higher Burgher School (established by Royal Decree of 10 August 1896, Bulletin of Acts and Decrees no. 149) shall be independent educational establishments;
A.II. that the Higher Burgher School shall prepare students for entrance to the State College of Agriculture, Horticulture and Silviculture.’[96]

To the uninitiated, this looks at first sight like an internal matter at Wageningen – the next in a long series of reorganizations of agriculture education. But a second Royal Decree followed on 12 December 1904, with reference to this one: as from 1 January 1905, Ritzema Bos was to be appointed to a teaching post at the State College of Agriculture, Horticulture and Silviculture in Wageningen, and hence relieved of his duties at the State School of Agriculture, which had since been abolished.[97] The plan was to attach an institute of phytopathology to the new State College, to be housed in the buildings and grounds of the disbanded Horticulture Department of the former School of Agriculture.[98] The 7,000 guilders’ grant for the Plant Protection Service was intended for this new institute, which would now be directly accountable to the government. Jan Ritzema Bos was to be its new director.

At the 14th annual meeting of the board of the Willie Commelin Scholten Phytopathology Laboratory on 1 April 1905, with all members present, the government representative Lovink – the architect of the recent reorganization of the State School of Agriculture – informed the board of this intention. Ritzema Bos observed that it seemed to him a highly rational decision on the government’s part to assign its funds for phytopathology to Wageningen, where they were indispensable, while the Institute would also be able to fulfil its purpose better in Wageningen than in Amsterdam, since it would have greenhouses and grounds at its disposal there, ‘without which a phytopathology institute cannot become what it should be.’[99]

The board accepted Ritzema Bos’s resignation, to take effect at the end of 1905. Quanjer too resigned his post. When the caretaker closed the door behind

[96] NA, 2.11.35, ‘Directie van de Landbouw, afdeling landbouwonderwijs 1898-1957’, inv. 108; for the institutional history of Dutch agriculture education, see J. Bieleman, *Geschiedenis van de landbouw in Nederland 1500-1950*, Meppel Amsterdam, Boom, 1992, pp. 237 ff.
[97] NA, 2.11.35, ‘Directie van de Landbouw, afdeling landbouwonderwijs 1898-1957’, inv. 153.
[98] See ‘Memorie van Toelichting chapter X. Staatsbegroting 1906’, p. 3.
[99] NWCS I, archives of the WCS.

him for the last time in April that year, the buildings of the Willie Commelin Scholten Phytopathology Laboratory stood empty again. 'Closed for an indefinite period', said a card affixed to the outside door.

The accommodation and budget in Amsterdam had obviously been far too limited, Ritzema Bos pronounced in retrospect.[100] Two rooms *en suite* and a small side-room full of instruments, collections and books, and only 'a town garden in Amsterdam, lying in the shadows cast by walls and high trees' in which to conduct experiments. 'Completely unsuitable.'[101] Thanks to the government grant, the whole looked rather less improvised than it had at the beginning. The space had been expanded, and an assistant appointed. All in all, and in spite of the limitations, Ritzema Bos had discharged his obligations well, as he said himself. 'For just look at the increase in the number of samples sent in' – not even counting verbal requests for information, and the fact that one letter often broached more than one problem. His relations with growers – 'item 1 on the programme!'[102] – would endure, he hoped, and even deepen, now that he was back in Wageningen. And that, after all, was where the subject really belonged.

'The study of phytopathology can only come into its own at an Institute of Agriculture. Teaching this applied subject at a university to which no agriculture institute is attached is more or less like lecturing in ophthalmology without a faculty of medicine.'[103] University botanists were simply uninterested in practical applications – that was the only reason why his lectures had fallen short of their objective.

'It was a great disadvantage that the director could not maintain contact, on a daily basis, with agriculturalists, horticulturalists and foresters or those who work in close proximity to them,' concluded the daily newspaper *Het Nieuws van den Dag* on 16 January 1906, in a piece on the opening of the new Institute of Phytopathology in Wageningen. 'However well-intentioned it may have been, the laboratory could not flourish in Amsterdam; had it been located in Wageningen from the outset, there would be have been no need for a new institute at this time.'[104]

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[100] J. Ritzema Bos, 'Het Phytopathologisch Laboratorium Willie Commelin Scholten van 1895 tot 1906', *Tijdschrift over Plantenziekten*, 1906, pp. 28-58.
[101] Ibid., p. 36.
[102] J. Ritzema Bos, 'Het Phytopathologisch Laboratorium Willie Commelin Scholten van 1895 tot 1906', *Tijdschrift over Plantenziekten*, 1906, pp. 28-58, cit. p. 46.
[103] Ibid., p.55.
[104] A. van der Tuin in *Nieuws van den Dag*, 16 January 1906, IIAV, archives of Westerdijk, no. 79.

It was above all at the beginning of his career that Ritzema Bos had a difficult time, his former students from Wageningen later recalled.[105] When he told them stories about the old days, the basic thrust was often that practising agriculturalists and horticulturalists were not keen on the interventions of 'that bug man.' 'Catch them and kill them', Ritzema Bos told his students grimly; according to fellow faculty members, this was the impracticable essence of his solid, earnest recommendations. Nonetheless, his students noted that Ritzema Bos always referred 'with satisfaction' to his time at the Willie Commelin Scholten Phytopathology Laboratory. That is a curious observation, since as far as can be ascertained, from his departure for Wageningen until his death in 1928, he never said another word about the Amsterdam laboratory in public.

The municipality of Amsterdam did pay tribute to *him*, however. In the 1950s, at a stone's throw from the wide, tree-lined avenue Hugo de Vrieslaan, it immortalized the name of its first professor of phytopathology, and 'the founder of phytopathology and of its state control in the Netherlands' by naming a narrow, crooked street after him; the Professor Jan Ritzema Bosstraat.[106]

[105] H. Lindeman, 'In memoriam Prof. Ritzema Bos', *Boerderij en Tuinderij*, 1928.
[106] Martha Bakker (ed.), *Stadsatlas Amsterdam*, Amsterdam Publishers, November 1998, p. 95.

3 The lady from Roemer Visscherstraat

Female students were no longer exceptional by the late 1890s. Between 1878, the year in which Aletta Jacobs became the first woman to take her final medical examinations at the University of Groningen, and 1905, when Ritzema Bos finally left Amsterdam for Wageningen, the proportion of female university students increased from 2% in the academic year 1895 to over 18% in 1904.[1]

The percentage of female biology students was traditionally much higher (25% in 1898; 63% in 1913).[2] A variety of explanations have been suggested for this. One is that biologists were regarded as peace-loving people who communed with nature in a way that gave them 'profound joy, pleasure and wisdom'[3] – something that evidently appealed to girls more than boys. Another is that biology was 'a good area in which… to find comfort for unfulfilled desires; one did not have to be a brilliant biologist to derive pleasure from it', as an admirer of Westerdijk's once wrote to her.[4] Then there were some professors who whispered that 'the ladies come here not to study biology, but to catch a husband. You never see them after their bachelor's exams. Once they get engaged, they take to embroidering cushions.'[5]

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1 These figures derive from G. Jensma and H. de Vries, *Veranderingen in het hoger onderwijs in Nederland tussen 1815 en 1940*, Hilversum, Verloren, 1997, pp. 192-194. The authors took their figures from the records in *Verslagen Onderwijs*. The statistics relate to students enrolled at the three state universities in addition to the Municipal University of Amsterdam (UVA) and the (Protestant) Free University (VU). Before 1895, women students were not registered separately. The figures are open to question, partly because women frequently studied part-time in this period, attending only a small number of lectures.

2 H.P. Bottelier, 'Zestig jaar biologen in AGLU', *Vakblad voor Biologen*, 1950, pp. 195-201. These figures relate to students at the State Universities of Groningen and Utrecht and the UVA. The State University of Leiden did not start registering female biology students separately until 1919. From then on, the proportion of female biology students at these four universities remained fairly constant, at an average of 39.5%. The average was slightly higher at the UVA, at 42.2% (compared to 39.8% at Groningen, 41.4% at Leiden and 36.9% in Utrecht).

3 J. Westerdijk, *Afscheidsrede aan de universiteiten van Utrecht en Amsterdam op 22 november 1952 te Hilversum*, p. 13.

4 D. Hillenius to Westerdijk, 22 December 1952, IIAV, archives of Westerdijk, no. 64.

5 Such notions might have derived support from the percentage of female students who went on to gain their doctorate. In the period before 1898, for instance, not one of the five female biology

Johanna Westerdijk (known familiarly as 'Hans'), who was born on 4 January 1883 and grew up in Amsterdam, gravitated to biology from her sheer love of nature – along with music, dancing and literature – which she greatly preferred to typical girls' pastimes like embroidery and playing with dolls.[6] As a young girl, and the eldest child of a general practitioner in Amsterdam, she drew inspiration – like hundreds of her fellow townspeople – from the immensely popular nature books written by the Amsterdam teachers Eli Heimans and Jacobus Thijsse. But it was not until she attended the lectures of Hugo de Vries that she became enthralled with the scientific aspects of biology.

'Strangely enough, however, [De Vries] would not allow the three new first-year students who arrived in 1900 to do practical laboratory work,' she wrote. 'Out of sheer rebelliousness I applied to the Willie Commelin Scholten Phytopathology Laboratory, where Dr C.J.J. van Hall, a man of my acquaintance and a former assistant of De Vries's, took me under his wing and instructed me on the anatomy of plants. He also taught me all about the yellow disease of hyacinths, bad patches in tulip cultivation, and the decay of greenhouse plants. When I confessed my sins to De Vries at the end of the year, he said dryly, 'So now you can attend the second-year laboratory classes'. By then, my interest in plant pathology had been awakened.'[7]

At the end of 1904, Westerdijk acquired a secondary-school teaching qualification for botany, zoology, geography and mineralogy.[8] She was only 21 years

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students registered at the UVA completed a master's degree course; and in the period 1898-1908 the ratio between those who gained a master's and those who did not was 2:3 (10 master's degrees out of 25). Not until the period 1908-1918 was this ratio reversed to 3:2 (30 out of 50), but in the following decade (1918-1928) women failing to complete the master's course again outnumbered those who did: only 30 gained a master's degree out of a total of 75 (1918-1928). Leaving aside the question of whether or not women persevered to the master's stage, for some their occupation after their studies may reflect the seriousness of their biology studies: on average, in the entire period from 1877 to 1928, only one out of five female biology students ended up working as biologists, as against one in every two of their male counterparts. See W.S.S. van Benthem Jutting, 'Vrouwen als biologen: Huldeblijk aan H.M. de Koningin van de Amsterdamsche Vrouwen', 6 September 1898-1938 (1939), Separatencollectie Library BCAH, UVA. The bleak professional prospects for biology graduates led Hugo de Vries to write a cautionary article for *De Levende Natuur*, the popular journal published by the Dutch Natural History Society, in 1900. Its message was evidently taken to heart: the number of biology students at the UVA fell from fifteen in 1899 to three in 1900. One of these three was Westerdijk.

6 See also M.P. Löhnis, *Johanna Westerdijk, een markante persoonlijkheid*, Wageningen, 1963; J. Westerdijk, *Afscheidsrede aan de universiteiten van Utrecht en Amsterdam op 22 November 1952 te Hilversum*; IIAV, archives of Westerdijk, no. 108.

7 J. Westerdijk, *Afscheidsrede aan de universiteiten van Utrecht en Amsterdam op 22 November 1952 te Hilversum*, pp. 1-2.

8 Westerdijk had attended a HBS for girls. Only those who had attended gymnasium were directly admitted to university; HBS school-leavers had to sit extra exams in Greek and Latin. The course

of age. At a time when the atmosphere at Roemer Visscherstraat was becoming increasingly grim, Westerdijk left Amsterdam to continue her studies in more joyful surroundings at the University of Munich.

The International Information Centre and Archives for the Women's Movement (IIAV) in Amsterdam has preserved the albums into which Westerdijk pasted her photographs. Three small snapshots with typical student antics recall her German university days. One yellowed photo bears the scribbled caption 'Kein Bier mehr da' ('No beer left'), and shows Westerdijk leaning on one elbow at a small round table with a glum expression, facing a male student in the same pose. The next photo's caption reads 'Schon wieder' ('Now there's more!'). The man and Westerdijk are now sitting up straight and grinning broadly, clinking their Bavarian beer mugs with panache.[9] The third German photograph shows Westerdijk in odd garb, leaning against a doorpost, a large curly moustache pencilled on her cheeks. 'So as not to be kissed in boy's clothes', she has written underneath.[10]

It is as a PhD student in Zürich that her name first crops up in the correspondence of the Willie Commelin Scholten Phytopathology Laboratory, as a potential new director. 'Here is what Hugo de Vries has to say', Went wrote to Scholten on 24 July 1905: 'I can heartily recommend Miss Westerdijk. She is one of our best pupils, calm and methodical and equipped with a fine mind. She has done a great deal of work, especially with the microscope, and although she has not yet studied plant diseases, I consider that her training makes her eminently suited to this work.'[11]

Given that she came armed with this 'glowing recommendation', it was certainly worthwhile sounding her out, said Went – 'provided Goebel [her supervisor in Munich] takes a similarly favourable view.' Just over a month later the appointment was arranged. Westerdijk was to take over as director on 15 March 1906, with an annual salary of 2,500 guilders.[12]

She had not been the executive committee's first choice. Other names that had been mooted were Van Hall (Ritzema Bos's former assistant), Jan Hendrik Wakker and Dr J.C. Schoute, a botanist who had graduated in Groningen and was then working at the State Seed Testing Station in Wageningen, and who had been warmly recommended by Professor J.W. Moll, a friend and colleague of Hugo de Vries's. The first two turned down the offer of the directorship

followed by Westerdijk (gaining the certificate 'K IV' and then going to a foreign university to take her PhD) was a legitimate and even quite common path – at any rate among the well-to-do.

9 IIAV, archives of Westerdijk, no. 92.

10 IIAV, archives of Westerdijk, no. 94.

11 Went to Scholten, 24 July 1905, archives of the WCS.

12 For purposes of comparison: Ritzema Bos earned 4,500 guilders.

Kein Bier mehr da

Schon wieder

Johanna Westerdijk, studying in Munich, c. 1905. International Information Centre and Archives for the Women's Movement.

for different reasons,[13] and Schoute was nominated only with some hesitation, in case Westerdijk too declined the post.[14]

All these botanists (including Westerdijk) had one thing in common: they were highly enthusiastic researchers. And that was the direction in which the Willie Commelin Scholten Phytopathology Laboratory should be moving, said Went.

A new direction

Ritzema Bos took everything with him: the personal title of professor of phytopathology at the University of Amsterdam, the Plant Protection Service (and its grant), the connections with agriculture, horticulture and silviculture, the assistant Quanjer, and even the phytopathology journal, *Tijdschrift over Plantenziekten*. For Professor Ritzema Bos it must have been 'a great pleasure no longer to have to deal with obstacles impeding his research.'[15] Equally, he must be pleased that 'numerous matters that had been awaiting resolution for years could now be dealt with.' At least, such was the opinion of the journalist reporting on the scientist's new appointment in Wageningen.

Ritzema Bos had already published a pamphlet on behalf of the Ministry of Agriculture, Industry and Trade the week before. The article itself has disappeared from the archives of the Willie Commelin Scholten Phytopathology Laboratory, but its content can easily be inferred from the reactions it provoked.

Scholten described it as 'a Parthian shot' at the Laboratory. 'There was never any lack of funds,' he wrote to Went. 'I always made up the difference myself when there was a shortfall… We are still taken for a ride on a daily basis, and when I spoke to his laboratory assistant yesterday and asked how it was possible that a cleaner had been taken on for 6 guilders a week since

[13] Van Hall wanted to remain in Suriname for the time being and Went himself hesitated in nominating him; he thought Van Hall not yet mature enough for the job, and did not really want to appoint him unless there was no one else. Wakker had by far the best papers for the appointment, but in 1905 he had abandoned academia for good, 'bitterly disappointed by what he saw as a lack of recognition for his scientific talent', Went wrote to Scholten on 12 July 1905, archives of the WCS. It is true that Wakker had been passed over for three professorships (at Utrecht in 1896 in favour of Went, at the UVA in 1896 in favour of E.Verschaffelt, and at Leiden in 1898 in favour of J.M. Janse) – partly, it appears, because of his 'inflexible nature'. He taught at the HBS in Den Bosch, and lived an isolated and embittered bachelor's existence until his death in 1927. See 'I.M. J.H. Wakker', *Vakblad voor Biologen*, 1927-1928, pp. 11-17.

[14] In 1917 Schoute succeeded his former teacher, J.W. Moll, as professor of botany at the University of Groningen.

[15] *Het Nieuws van de dag*, 16 January 1906, IIAV, archives of Westerdijk, no. 79.

1 November, and enquired whether there was enough work for her, he said 'What you see is only one page in a whole book'. Should we simply swallow all this and act as if nothing untoward had happened here?'[16]

'I hardly need tell you how indignant I was at Ritzema Bos's more than disgraceful conduct', replied Went. 'I shall make it my business to relate this as widely as possible, so that it will at least be known what kind of people one is dealing with. In any case, I have noticed recently that R.B. is not thought of very highly, either in academia or in the agricultural world. His own self-glorification in the newspapers might impress an ignorant public, but experts take a different view – and ultimately it will be the laboratories' work that will show which takes pride of place; I have no fears as to which of the two will win.'[17]

Ritzema Bos's departure created opportunities for a new beginning – this time without any restrictions imposed by grant-dangling authorities, universities, or official decrees regarding administrative methods or the director's sex, and with the benefit of the experience generated by eleven years of phytopathology in Amsterdam. 'Free again!' Went exclaimed in undisguised relief.[18]

'A phytopathology laboratory can perform its task in two different ways', Went began what was for him a long letter in 1905, blissfully unaware that De Vries had said exactly the same thing twelve years earlier. His analysis of the different working methods was also the same as De Vries's. On the one hand there are known diseases, requiring little if any supplementary research, he explained, and on the other hand there are unidentified diseases, which may become the object of research projects. Plants afflicted by the former category are dealt with by plant doctors; only those attacked by the latter are the business of researchers. Up until then, the Willie Commelin Scholten Phytopathology Laboratory had dealt with both categories, which had placed a strain on its research capacity. The information service would now move to Wageningen. 'Let us rejoice in this change and renew our efforts to affirm the Laboratory's other, higher purpose – as an institute that researches plant diseases.'[19]

Other options were also suggested. Ernst Krelage, for instance, revived the old idea of making the Laboratory into an 'experimental station.' But Went thought this an ill-conceived plan. It would call for more staff and more experimental plots – in short, more money – and would perhaps end up again overlapping with the work being done in Wageningen. The Laboratory's limited

[16] Scholten to Went, 12 January 1906, archives of the WCS.
[17] Went to Scholten, 26 January 1906, archives of the WCS.
[18] In response to the notification that the government grant was to be stopped, Went wrote: 'Now we are completely free, and the Government can no longer meddle in the Laboratory's affairs.' Went to Scholten, 8 November 1905, archives of the WCS.
[19] Went to Scholten, 6 April 1905, archives of the WCS.

budget and its urban location called for modest, realistic aspirations. Went well knew that true science could flourish perfectly well in these conditions. It is worthwhile briefly examining the background to this conviction.

The pursuit of knowledge had been part of Dutch university life for over three centuries by this time, but it had completely shifted ground in the last quarter of the nineteenth century. Initially a marginal activity that professors practised as a private sideline, it now ranked alongside teaching as one of their primary tasks. For decades now, research had been one of the core tasks of any professor, with all the methodological consequences this entailed for their students: they no longer learned just by listening, but above all by practical work. The principle of 'learning-by-doing' had arrived – a principle that remains prominent to this day.

When the Athenaeum Illustre was promoted from a college to the University of Amsterdam in 1876, one of the consequences was the appointment of Hugo de Vries as extraordinary (that is, part-time) professor of experimental plant physiology in 1878. Together with future Nobel Prize-winners Jacobus van 't Hoff (Amsterdam 1901), Pieter Zeeman (Amsterdam 1902), Hendrik Lorentz (Leiden 1902), Johannes Diderik van der Waals (Amsterdam 1910) and Heike Kamerlingh Onnes (Leiden 1913), De Vries entered what present-day accounts describe as a scientist's paradise: most of them had little teaching experience and took a keen interest in research. An increase in professorships combined with far smaller student numbers meant that science professors had more time to do research and to tutor gifted students.[20]

All these professors, appointed between 1877 and 1886, shared a number of characteristics that clearly distinguished them from previous generations of scientists. Most of them had attended HBS, the modern type of secondary school, rather than gymnasium with its large dollops of Latin and Greek. They had a more international orientation than their predecessors. They had been appointed on the basis of their capacity for research rather than their teaching experience. They were better paid. And finally, they had relatively small numbers of students.[21]

These characteristics derived – not in all cases intentionally – from the Higher Education Act that was approved by parliament in 1876, and the introduction of the new HBS schools in 1863. The popularity of the HBS, which was far more biased towards practical subjects than the classical gymnasium and was therefore more attractive to young people from the fast-growing

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[20] B. Willink, 'Origins of the Second golden Age of Dutch Science after 1860: Intended and Unintended Consequences of Educational Reform', *Social Studies of Science*, vol. 21, 1991, pp. 503-526.

[21] P. Faasse, *Between seasons and science*, Amsterdam, SPB Academic Publishing, 1995.

bourgeoisie, transformed the size, nature and prospects of the late nineteenth-century student population.

The initial effect was actually to decrease student numbers, since the HBS quickly became popular at the expense of the gymnasium, and HBS school-leavers were required to sit extra examinations in the classics to qualify for university admission – something few were prepared to do. Instead, many of them followed a roundabout route: some acquired various certificates that enabled them to study for a doctorate at a foreign university, while others secured a foundation course certificate or *propaedeuse* abroad, after which they could transfer to a Dutch university. So a relatively large number of HBS school-leavers ended up pursuing careers in the natural sciences – some of them going on to acquire professorships and several winning Nobel Prizes.

All this had the effect of boosting the numbers and prestige of the science faculties at the expense of the once so revered humanities – traditionally the heart of every self-respecting university. And uncharted territory beckoned: the scientists' PhDs not only provided access to the halls of academe, but also demonstrated competence in new professions, many of which were as yet ill-defined.

Hugo de Vries was one of these new professionals. He was the first professor of botany without any medical qualifications – in fact without any ambition in that direction. This compelled him to strike out along new avenues and to seek contact with the large and expanding network of plant physiologists in Germany, Britain, Austria-Hungary, the United States and France. In their hands, botany developed into an independent scientific discipline with its own standards, specialist skills and aspirations.

This 'new' botany became an experimental science, which focused on unravelling the mysteries of the plant's normal functions: breathing and transpiration, growth and reproduction. While 'old' botany, which was dominated from then on by taxonomists, concentrated on listing and identifying the differences between plants, plant physiologists such as De Vries were more interested in the processes that plants had in common. This also entailed a different choice of research locations.

Taxonomists theoretically travelled around the globe, collecting, drying, describing and naming all the plants they could find, and once they returned home, arranging and classifying them in a herbarium. All physiologists needed was a sample plant in a laboratory. While for a herbarium *stability* is paramount – otherwise the meticulous classification will be disrupted – what matters in a laboratory is precisely the degree of *variation*. To assess the influence of diverse factors on a plant's life functions, the researcher must be able to vary each one while maintaining the others constant. To learn about life processes, one must be able to control and manipulate light, moisture, temperature, and nutrition.

De Vries was in the vanguard of a generation of 'new' botanists, which included Went, Wakker and Westerdijk. While his research was still literally experimental – many scientists in the 'old guard' were sceptical about the whole concept of experimental science as a means of acquiring knowledge – for his students, the fundamental principles of plant physiology and the places where they conducted their research soon became as unquestionable as the legitimacy of their research questions. The erection of modern, well-equipped university laboratories at the beginning of the twentieth century, along with rising student numbers, consolidated the success of the new approach to botany.[22]

Many biologists no longer spent their days roaming around the woods, meadows and moors, on the banks of ditches or in herbaria. Instead, they were to be found in the red light of darkrooms in basement laboratories, bent over perfectly aligned rows of plant blades carefully arranged in standard-sized basins, exploring questions such as whether they leant to one side under the influence of light. If so, how much light? And why?[23]

This was what Went had in mind after the departure of Ritzema Bos: a small but methodically designed laboratory, where various principles of as yet unidentified plant diseases could be explored in experimental research, on the basis of which rational ways of controlling them could be devised. The focus was to be on the general rather than the specific properties of plants and their diseases: syndromes would have to be *explained*, not merely *described*. This presupposed that each element of the disease process could be frozen, dissected, varied and then analyzed. And this, said Went, was the terrain of a scientifically trained botanist.[24]

Westerdijk was precisely such a scientifically trained botanist. Her PhD thesis is the typical product of a purely intellectual, academic tradition, which appears intentionally impenetrable for non-initiates. 'But what is the title of your thesis?', her father asked despairingly. 'People ask me and I can't tell them, it's so maddening.'[25]

The research question of her thesis is physiological and morphological, and relates to the development of different moss growths. 'Thus the object of the

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[22] In brief: a new laboratory opened in Leiden in 1908; in Amsterdam in 1915; in Utrecht in 1918; in Groningen around 1920; and in Delft in 1924.

[23] The example is taken from growth research such as that conducted at Utrecht's botany laboratory and analysed in P. Faasse, *Experiments in Growth*, Ph.D. thesis Amsterdam, 1994.

[24] See also F.A.F.C. Went, 'Plantkunde en Landbouw' ('Botany and Agriculture'), address given to the 135th meeting of Utrecht Provincial Society of Arts and Sciences on 3 June 1908, by the Society's president. This speech elicited an angry retort from Ritzema Bos, who accused Went of exaggeration. See J. Ritzema Bos, 'Plantkunde en Landbouw', MRHLTB vol. III, 1909.

[25] Westerdijk to Westerdijk, IIAV, archives of Westerdijk, no. 72.

following research is to determine the different conditions in which protonemata on the one hand, and rhizoids on the other, develop in mosses, and how one may be transformed into the other', she wrote.

In *Zur Regeneration der Laubmoose* ('On the regeneration of *Musci*') she recapitulates her months-long research on the different growths in this group of organisms (ten species in total), in different conditions (in light and darkness), and under the influence of different interventions (arranging the mosses horizontally or vertically, and varying the culture media). Given the considerable variety in her experimental set-ups, her Zürich laboratory must have been extremely modern and well-equipped by the standards of the day. She would not have been able to conduct this research in Amsterdam or Utrecht at that time, let alone at the Laboratory of which she had now become the director.

After a brief visit to Munich – 'Enjoy yourself, and you should certainly take the opportunity to thank Goebel and talk to him again', counselled her father[26] – Westerdijk returned to Amsterdam. Her salary would be slightly more than half of that received by Ritzema Bos, and she would have to do without any assistants and without a journal for the time being. Even so, she was delighted with her new position.

'What a glorious apotheosis!', her father exclaimed in jubilation. 'What a splendid way to crown a fine academic career! Just 23 years of age, awarded a PhD *cum laude*, appointed director of the Phytopathology Laboratory, full of vitality and energy, I cannot imagine or dream of a better way to conclude a particular stage of life, or one that holds out greater promise for the next.'

'Now that the information given to agriculturalists and horticulturalists about instances of disease will henceforth be provided mainly by the institute in Wageningen, the Laboratory in Amsterdam will be better able than in the past to prioritize research on plant diseases', Went promptly told the press.[27] 'For only meticulous research can lead to rational means of disease control in our crops, although the ties with practical agriculture and horticulture must be preserved at the same time.'

Westerdijk and the Willie Commelin Scholten Phytopathology Laboratory would have to demonstrate the *raison d'être* of a scientific laboratory for studying plant diseases in Amsterdam. How should they go about it?

[26] Ibid.

[27] *Het nieuws van de dag*, undated, IIAV, archives of Westerdijk, no. 79.

Fungus lady

Ritzema Bos permitted himself one last public comment about the Willie Commelin Scholten Phytopathology Laboratory. 'Now that this institution is to be led by a lady who has only recently completed her university studies, who did, it is true, practise pure mycological work for some time under the supervision of my then assistant Dr Van Hall, but who has thus far devoted little time to actual phytopathology, and who has had nothing to do with the cultivation of the soil – the Willie Commelin Scholten Phytopathology Laboratory will necessarily change direction entirely. It will take on the character of a private laboratory; the talented director will do botanical and perhaps even phytopathological research; but the institution will no longer have any direct links with growers. Still, one may not entirely rule out the possibility that some of the research conducted there may prove, in the long term, to be not completely without benefit to growers.'[28]

'Treacherous words indeed,' wrote Went. 'But it seems to me that few will be taken in by them; anyone who can read will clearly see that it all comes down to the self-glorification of R.B. (in his own journal!) along with a defence against a non-existent attack … And as far as the journal *Tijdschrift over Plantenziekten* is concerned, let us be thankful to be rid of it. … In my view it is all waste paper, and we are now completely free where our own publications are concerned.'[29]

It was perfectly true that Westerdijk was inexperienced in phytopathological research; certainly in comparison to Ritzema Bos, who had been advising on plant diseases for decades when he became director. Furthermore, her interest and training were primarily botanical/mycological and not entomological – Ritzema Bos's specialism. Westerdijk's concept of phytopathology research was more in line with the prevailing definitions of phytopathology in the United States. Phytopathology and entomology were two separate disciplines there, a distinction that was relatively uncommon in Europe and that Ritzema Bos himself vehemently rejected.[30]

Westerdijk's bias was reinforced when Went asked her to take over managing his small collection of fungi (no more than fifty in total) a year after she had been appointed director. One of Went's assistants had been taking care of

[28] J. Ritzema Bos, 'Het Phytopathologisch Laboratorium Willie Commelin Scholten', *Tijdschrift over Plantenziekten*, 1906, pp. 28-29.

[29] Went to Scholten, 12 September 1906, archives of the WCS.

[30] See chapter 2: the two disciplines were institutionalized in the Departments of Phytopathology and Departments of Entomology, respectively, or even in a Department of Phytopathology and a Museum of Zoology.

them up to then, but after her departure they were in danger of wasting away in the basement of his laboratory.

At the beginning of the century, this collection had been formally entrusted as the 'Zentralstelle für Pilzkulturen' to the 'Association Internationale des Botanistes', a small group with ambitious plans. One of these plans was to create a universal reference collection managed by and for the entire botanical community, to end disagreements about naming and classifying species, which would enable the botany community to advance in giant strides. Went's private collection from the East Indies was the beginning of it, and although he had serious doubts (which later proved fully justified) regarding the feasibility of the Association's original megalomaniac ambitions, he was convinced of the potential importance of preserving an accessible collection of fungi.

Westerdijk was to become, and remained until a few years before her death, the director of what was known after the First World War as the Central Bureau of Fungal Cultures. Under her leadership the Bureau became an internationally respected and much-consulted institution, and today it possesses independent status as an Institute of the Royal Netherlands Academy of Arts and Sciences. But the collection of fungi, small and neglected though it may have been at the beginning, was also of great significance to her work as director of the Willie Commelin Scholten Phytopathology Laboratory.

The Laboratory would produce two different publications, Went had said: a Dutch one with brief notices for growers, and a foreign-language one with full-length studies for scientists.[31] A third type of publication – the Laboratory's annual reports – illuminates Westerdijk's activities in her Amsterdam period.

One of her first research projects involved bulb rot, a disease that can affect various bulbs including tulips, hyacinths, Muscari, Chionodoxa, and Fritillaria.[32] It had been cropping up at irregular intervals for twenty-five years, and had often been studied; Van Hall had drawn Westerdijk's attention to it while she was a student, and besides Wakker and Ritzema Bos, the German professor H. Klebahn had also tried to identify the cause. Westerdijk, following Klebahn, now confirmed that the disease resulted from two different fungi: one found underground (*Sclerotium tuliparum*), already identified by Klebahn, and another one above the ground (*Botrytis parasitica*) which Ritzema Bos had previously designated as the sole cause of the disease. By conducting infection experiments, she determined the moment of infection for both fungi: *Botrytis* did not infect the plants until the bulbs started to sprout, while *Sclerotium* caused the

[31] Went to Scholten, 12 September 1906, archives of the WCS.
[32] WJPLWCS for 1906.

bulbs to rot in the ground *before* sprouting. This latter fungus, according to Westerdijk, was therefore the 'real' cause of the bulb rot, which manifested itself in patches of bulbfields ('kwade plekken' or 'bad patches') in which few if any plants would come up. Westerdijk promised that she would report at a later stage on experiments with carbon disulfide in the soil 'after more extensive tests have been conducted',[33] a promise that she made good over the following years.

In the annual report for 1906 she reported on another series of experiments on bulb disease, this time involving tulip fire, a nematode disease that attacked the tulip *La Reine*, and a bacterial disease in irises. Who encouraged her to conduct these research projects she does not say, but they appear to reflect the influence of the board member and bulb-grower Ernst Krelage. She also gives no indication as to what prompted her to conduct research that year on the rotting of apples and on diseases in caraway, raspberries, oats and beets, and to test the effect of certain chemicals (spraying with soap to control mildew in roses, Welling's Insect Cider to control whitefly in azaleas, and Schacht's fruit-tree carbolineum). But the extant correspondence suggests that the research was prompted by queries received from farmers, horticulturalists, growers, private gardeners, dealers and teachers at the State Horticultural College. However much the Institute of Phytopathology in Wageningen may have advertised itself as a centre for practical advice, while Went sought to present the Willie Commelin Scholten Phytopathology Laboratory as a research institute, the postbag continued to carry a steady stream of diseased bushes, berries, leaves and twigs to the laboratory at Roemer Visscherstraat, each specimen acompanied by the obvious questions: what has caused this disease? And what can be done about it?

Far fewer specimens were sent to the laboratory than in the days of Ritzema Bos. But Westerdijk, together with her permanent assistant A. van Luyk (from 1910 onwards), took these enquiries extremely seriously, and answered them no less conscientiously than Ritzema Bos had done in his day. They sometimes asked for more, somewhat less diseased specimens, or made appointments to come and look at the crop, on occasion they attributed the disease to weather conditions, a fungus, a bacteria or an insect, and at other times they were at a loss, and advised the grower to remove the diseased parts and hope for better luck the following year.

This practice continued for many years, and it occasionally led to more detailed research, which is clear from information in the annual reports about research on diseased winter wheat from Groningen, mosaic disease in tomatoes,

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33 Ibid., p. 8.

damping off, a case of poisoning in horses caused by mouldy hay, *Aphanomyces* blackleg in beets, diseases of peas, a variety of bulb diseases, and spraing disease in potatoes.[34] And after Westerdijk had acquired the use of a small experimental garden on Amstelveenseweg in 1908, factories and growers frequently asked her to test the effectiveness of specific pesticides.

Besides all this, she was constantly looking for suitable culture media for the fungi in the 'Zentralstelle', and it soon became clear to her how demanding the tiny organisms were. Fungi, she reported, do not like stable conditions and they are decidedly averse to all being subjected to the *same* conditions. The secret of a flourishing collection of fungi is to devote attention to each little fungus individually. One needs more light, another prefers a lower temperature, a third might flourish on a somewhat sweeter medium, a fourth might need more moisture and a fifth requires something else entirely. 'Since then, many species were at times grown at different temperatures, and some were cultivated in bright light,' she wrote much later. 'And this taught us for once and all that life – even in fungi! – demands variety and contrasts.'[35]

November 1909 witnessed the publication of the first pamphlet by the Willie Commelin Scholten Phytopathology Laboratory, *De Wortelbrand der Bieten en zijne Bestrijding* ('Blackleg in beets and its control'), reporting the findings of an experimental comparative field survey combined with small-scale experiments in garden pots and meticulous laboratory work. In March 1910 followed Westerdijk's first publication of the type that Went had described as 'full-length studies for scientists.'

'Die Mosaikkrankheit der Tomaten' ('Mosaic disease in tomatoes'), the first in a series of *Communications* (*Mededeelingen*) from the Willie Commelin Scholten Phytopathology Laboratory, contains all the ingredients that would later prove characteristic of Westerdijk's views concerning sound phytopathology research.[36] These ingredients may be summarized as follows. The research is presented in the context of ongoing studies (in this case in Germany, the Netherlands, Russia and the United States), thus demonstrating the author's familiarity with the recent literature and the work of other research teams. It contains her own observations of the disease in the field, with detailed colour drawings of the syndrome (in this case blotchy leaves) and photographs of the tomato plant in a variety of experimental set-ups; in other words, the researcher had conducted the experiment herself, in this

[34] WJPLWCS for 1907-1908, 1909, 1910, 1911.

[35] J. Westerdijk, 'Siebenundvierzig Jahre Arbeit in der Phytopathologie', *Mitteilungen aus der Biologischen Bundesanstalt Berlin-Dahlem*, no. 80, 1954, p. 13.

[36] J. Westerdijk, 'Die Mosaikkrankheit der Tomaten', *MPLWCS*, vol. 1, 1910, pp. 1- 26.

way confirming or refuting the findings of others. Another important feature is that the article reports on infection experiments in the field, in the greenhouse and in the garden, spanning different seasons and several years, thus making the research reproducible and its findings verifiable. In addition, it recapitulates the Laboratory's experiments with different levels of brightness and efforts to transfer the disease by inheritance; that is, the work is experimental, which means that its findings may run counter to everyday experience in uncontrolled conditions. And finally, it enumerates conclusions, thus generating new knowledge.

The only unusual feature of this research was that it focused on a *viral* disease and viral pathogens could only be described in negative terms around 1910. In Westerdijk's words, 'The pathogen can be identified as a "virus", since no organisms are present.'[37] Or to quote a recent study by the science historian Ton van Helvoort: '[it was then] suggested that viruses could be distinguished from other pathogenic microorganisms because they were characterized by three negative properties, namely, invisibility by ordinary microscopic methods, failure to be retained by filters impervious to well-known bacteria, and inability to propagate themselves in the absence of susceptible cells. It will be clear that these properties are negative in relation to the *paradigm of bacteriology*, which interpreted infectious agents as autonomous living microbes.'[38]

In the next scientific *Communication* from March 1911, 'Untersuchungen über *Sclerotinia libertiana* Fuckel als Pflanzenparasit' ('Studies of *Sclerotinia libertiana* Fuckel as a plant parasite'), Westerdijk was also able to provide some *positive* facts about the pathogen. This study possessed all the characteristic features of her research as summarized above, besides which it clarified certain properties of the pathogen – in this case, the physiology and morphology of the fungus *Sclerotinia libertiana*. This type of research would make Westerdijk world-famous in her field.

She toiled tirelessly to classify pathogenic fungi on the basis of their 'natural' appearance in pure culture, abandoning previous classifications based on the host plant, discoverer, or the site where a fungus had first been found. For too long, she would maintain towards the end of her career, the development of phytopathology had been impeded by the inept classification and naming of fungi. One fungus was wrongly classified as a pathogen – in reality it merely caused decay in a plant that had already been attacked by a pathogen – and another was referred to by up to seven different names in the literature. Creating order in this chaos was a herculean task.

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[37] Ibid., p. 20, Schlussfolgerung 2.

[38] T. van Helvoort, 'Virus research in the twentieth century', *History of Science*, 1994, pp. 185-235, esp. p. 186.

Westerdijk with Catharina Cool (l.) and Catharina Petronella Sluiter (r.), Amsterdam, c. 1918. Archives of the WCS, Haarlem.

Here, Westerdijk's two positions (as director of the Willie Commelin Scholten Phytopathology Laboratory and as director of the fungus collection of the Association Internationale des Botanistes, later known as the Central Bureau of Fungal Cultures) were mutually beneficial. Her next two *Communications* both related to the correct identification of plant pathogenic fungi (or groups of fungi).[39]

In several respects, these scientific publications represented a break with the past. To start with, they were written not for growers but for other phytopathologists. Her *Communications* targeted only this group, and would in fact have been fairly unintelligible – if only because of the Latin nomenclature, footnotes and bibliography – to ordinary farmers and growers, who had no access to the scientific literature cited. In other words, only those who spoke the language of phytopathology could join in the discussion. Others would have to direct their queries and comments elsewhere.

Secondly, by placing every *Communication* in the context of ongoing research, Westerdijk helped to build up continuity in phytopathology. Invoking earlier research, and presenting the findings of the present as contributions to solving problems stated in the past, created the impression that phytopathology as a science was steadily advancing. 'See, we are making progress!' was the message conveyed by this mode of presentation. 'See how the questions asked in the past are now being answered!'

Thirdly, Westerdijk's references to past research were far from random. By selecting methodically when citing the earlier research, she created a certain tradition and placed herself in it; thus intentionally excluding certain other possibilities in the process.[40] Imposing order on the past, she provided a justification for the present. The implication was that the relevance of the problems dealt with in the *Communications* was primarily scientific; they were no longer placed in an economic, industrial or political context. These articles were published for one reason only: the pursuit of the truth.

This is how pure science is created. Through its *Communications*, the Willie Commelin Scholten Phytopathology Laboratory cast off its old reputation as an information service. It had become an institute that practised pure science – even without a professor at its head.

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39 *MPLWCS*, vol. 3, 1912, consisting of three articles, and *MPLWCS*, vol. 4, 1920, consisting of four articles.

40 It is striking, for instance, that Westerdijk herself never cites any of Ritzema Bos's work – at least, she does not do so in a single one of her articles in the *Mededeelingen uit het Phytopathologisch Laboratorium 'Willie Commelin Scholten'*.

In 1919 this scientific approach culminated in the publication, by Westerdijk and the German phytopathologist Otto Appel, of an entirely new method of classifying plant diseases. While this classification cannot be called a textbook, because 'Die Gruppierung der durch Pilze hervorgerufenen Pflanzenkrankheiten' is ostensibly an average-length article among other articles in a journal, it introduced an entirely new principle for the classification of plant diseases, and thus represented another radical break with the past.

Until then, the classification of plant diseases had been attuned to the presumed user: Ritzema Bos's standard work *Ziekten en Beschadigingen der Landbouwgewassen, c.q. Ooftbomen, c.q. Kultuurgewassen*, for instance, classified them according to the host plant. By consulting a tree diagram – a system also used in Heukels's immensely popular *Flora*, a reference work reprinted countless times – branching into mutually exclusive choices, the reader arrived at a possible diagnosis. Which crop was involved? Potato? Go to page 45. Which part of the plant has been attacked? Foliage? Go to page 47. What does the diseased foliage look like? Curly, limp leaves? Go to page 50. And so on.

Mycologists had adopted a different, purely scientific method. But only those familiar with the taxonomy of fungi could use it to identify a specific pathogenic fungus.

Westerdijk and Appel saw advantages in both systems, but noted that 'we do not yet possess a classification of diseases that is based on the *nature of the symptoms of the disease* … Yet it is reasonable to expect phytopathologists to base their views on the symptoms of disease and the connections between them.'[41] Just as eighteenth-century taxonomists had distinguished between *natural* and *artificial* classifications of the plant kingdom, Appel and Westerdijk distinguished between the *practical*, *mycological* and *phytopathological* classification of plant diseases; for the latter, they considered that the outward symptoms constituted the most *natural* building-blocks.

This principle led them to propose a classification based on five main groups: '1. Rot, 2. Blotches, 3. Fungal growths, 4. Rampant growth, 5. Vascular diseases,'[42] each of which was subdivided into smaller groups. 'It has become clear to us over the past few years, especially in the teaching of phytopathology, that a classification of plant diseases based on these foundations leads to a better understanding of the diseases', they wrote in justification of their new system. Partly because of its didactic advantages, this

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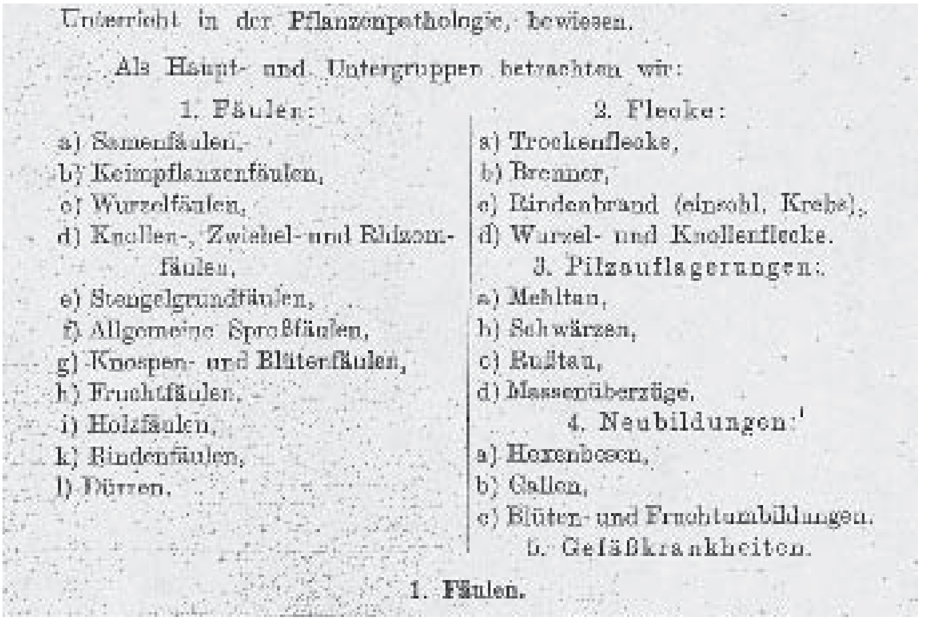
[41] O. Appel and J. Westerdijk, 'Die Gruppierung der durch Pilze hervorgerufenen Pflanzenkrankheiten', *Zeitschrift für Pflanzenkrankheiten*, vol. XXIX, 1919, issues 4/5, pp. 176-186, esp. p. 176-177 [italics mine].

[42] Ibid., p. 180.



Unterricht in der Pflanzenpathologie, bewiesen.

Als Haupt- und Untergruppen betrachten wir:

1. Fäulen:
a) Samenfäulen,
b) Keimpflanzenfäulen,
c) Wurzelfäulen,
d) Knollen-, Zwiebel- und Rhizomfäulen,
e) Stengelgrundfäulen,
f) Allgemeine Sproßfäulen,
g) Knospen- und Blütenfäulen,
h) Fruchtfäulen,
i) Holzfäulen,
k) Rindenfäulen,
l) Dürren.

2. Flecke:
a) Trockenflecke,
b) Brenner,
c) Rindenbrand (einschl. Krebs),
d) Wurzel- und Knollenflecke.

3. Pilzauflagerungen:
a) Mehltau,
b) Schwärzen,
c) Rußtau,
d) Massenüberzüge.

4. Neubildungen:[1]
a) Hexenbesen,
b) Gallen,
c) Blüten- und Fruchtumbildungen.

5. Gefäßkrankheiten.

1. Fäulen.

Diagnostic classification scheme devised by Appel and Westerdijk. *Zeitschrift für Pflanzenkrankheiten* 1919, p. 180.

new mode of classification gradually took hold, although it was initially taught only at the Willie Commelin Scholten Phytopathology Laboratory.

Prospects of a professorship

At the beginning of 1912 Westerdijk considered applying for a grant from the Buitenzorg Fund, so as to be able to go to the East Indies, just like Went, Wakker, Treub, Van Hall, and numerous other botanists, on whom a stay in the tropics had proved a lasting and formative influence.

A stay in the East Indies was a measure of a botanist's development as a scientist and of an individual's development as a human being. Everything in the tropics seemed to invite superlatives. The conditions were more extreme there, plant life was more remarkable, and the very life functions of plants were writ large, as it were: more impressive, almost exhibitionist, as if they had been created especially for botanical study. The archipelago possessed a different range of plant parasites than the cold north, parasites that attacked different crops (coffee, tea and tobacco plantations) and threatened different sectors of economic life (rubber and cane sugar production). Economically the colonies were indispensable to production, and scientifically and aesthetically they offered an experience beyond compare. Someone who had never seen the superb, lush vegetation of the East Indies scarcely counted.

'Only there does one learn about plants in all their vitality, and does one clearly understand what a powerful factor the struggle for existence is in the development of a region's flora', wrote Went at 27 years of age after his first visit to Buitenzorg (as the first beneficiary of the Buitenzorg Fund) in 1890.[43] 'So a botanist will be beset by numerous new questions when he is in the tropics, and will start to question the truth of a range of assumptions entrenched in Europe.'

'I would warmly applaud the idea of your going to Buitenzorg next year with the specific goal of familiarizing yourself with the diseases of tropical crops', he wrote in answer to Westerdijk's enquiry regarding the availability of funds for 1913. 'And for the rest, your letter prompts me to put a question to you. Would you consider lecturing on plant pathology to my students in Utrecht? I have always considered it a pity that they hear so little about it, while they often have to deal with it in practice. You would be doubly suited to give such lectures if you had seen the diseases of tropical crops with your own eyes.'[44]

Westerdijk's reply has not been preserved. But its gist can be inferred from Went's next letter. 'Dear Miss Westerdijk, I am extremely happy to be the bearer of two good tidings. In the first place, the Academy selected you last Saturday as its candidate for the Buitenzorg Fund, which means that it will nominate you to the Minister of the Interior; the matter must be kept secret until the minister has made his decision, however. In the second place, the faculty discussed the teaching of phythopathology this afternoon, and decided to nominate you for the position of extraordinary professor of phytopathology, at an annual salary of 200 guilders.'[45] This too was to be kept secret.

'You have certainly sent me two extraordinarily wonderful tidings', punned Westerdijk.[46] 'I had never imagined you giving me such a distinguished title – it took me by surprise. It is to be hoped that the minister will give it his seal of approval. I shall do my utmost to ensure that my lectures are not boring; that is an idea that has always made me shudder.'

The nomination submitted by the mathematics and physics department to the board of governors of Utrecht University is dated two days later.[47] The

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43 F.A.F.C. Went, 'Verslag omtrent de onderzoekingen, verricht aan het Botanisch Station te Buitenzorg, van 15 maart – 1 augustus 1890', *Verhandelingen Koninklijke Akademie van Wetenschappen,* 1891.

44 Went to Westerdijk, 30 April 1912, copy in the archives of the WCS.

45 Went to Westerdijk, 2 July 1912, copy in the archives of the WCS.

46 Westerdijk to Went, 4 July 1912, archives of Westerdijk, MB, Leiden.

47 FWN to CC, 6 July 1912, *Het Utrechts Archief*, 59 – inv. no. 656.

Ministry of the Interior replied a few weeks later, stating that although the nomination was too late to be considered for 1913, it would be included in the national budget for the following year.[48]

From October 1913 to June 1914, Johanna Westerdijk lived in the Dutch East Indies as the first woman recipient of a grant from the Buitenzorg Fund. A separate grant by the colonial government enable her to prolong her stay a few months. She collected parts of plants from a variety of diseased crops (including coffee, tea, tobacco, sugar, cocoa, rubber, and rice), and made cultures of parasitic fungi.[49] While she was away, Willie Commelin Scholten's father died at the age of 74, on 7 January 1914.

Compelled to leave by the outbreak of the First World War, she travelled back to the Netherlands via Japan and the United States, a roundabout route that considerably delayed her return. In December 1914 she arrived in Amsterdam, where she learned how Van Luyk had held the fort in her absence, discussing difficulties first with Johanna's father, Dr B. Westerdijk, and only then with Scholten's widow.[50]

Her professorial appointment progressed just as slowly as her journey home. In both cases, the complicated circumstances of the wartime years were to blame. Westerdijk, who had by then served as director for ten years, requested a rise in salary, but the board thought it too risky. 'I told Spakler [treasurer of the board of the WCS] that you wanted to raise my salary – but it seems that in wartime such urges must be restrained', Westerdijk grumbled to Went.[51] 'Personally I hardly expect the situation to be any more favourable after the war. Perhaps Mrs Scholten might be less fearful and more inclined to consent then, but who knows how long these horrors will last.'[52]

She was doubtful as to the Laboratory's future prospects. 'The greatest objection to this lab remains that no one knows what direction it is going in, and no one knows where he stands. Mrs S. refuses to tell me anything.'[53] Her own prospects also troubled her. 'It always seems to me that the rent is high here [1,500 guilders a year, with an income of 2,500 a year] while the accommodation is poor. I must also tell you that if I never have any prospects of a larger house, I might not be able to resist the temptation of going to the East Indies.

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48 BZ to CC, 26 July 1912, *Het Utrechts Archief*, 59 – inv. no. 656.

49 'Verslag van de werkzaamheden van Mej. Dr. Johanna Westerdijk, verricht in Nederlandsch Oost-Indië, naar aanleiding van het Buitenzorgfonds', Bijvoegsel (annex), *Nederlandsche Staatscourant* of Saturday 13 February 1915, no. 37.

50 Correspondence in 1913 and 1914, archives of the WCS.

51 Westerdijk to Went, 14 March 1916, archives of Westerdijk, MB, Leiden.

52 Ibid.

53 Ibid.

After all, this situation can only endure because I am a woman (neither the space nor the money would suffice for a family).'[54]

She looked for ways of improving her situation, but found her path blocked by the indomitable Mrs Scholten, who was intransigently set in her ways. 'Her point of view is that "the next person will always turn everything upside down and ignore the principles adopted by his predecessor". She fails to appreciate why I should concern myself with the future.'[55]

Then the Ministry sent notice, at the end of April 1916, that the requested 200 guilders a year for Westerdijk's appointment as extraordinary professor of plant pathology would be included in the budget for 1917. The news was unexpected, after previous requests had been turned down because of the war. A Royal Decree of 3 January 1917 sealed the appointment, and on Saturday 10 February 1917, at precisely 2.00 p.m., Westerdijk rose to give her inaugural address, on 'The new paths in phytopathology research', in the main hall of Utrecht University.

The crowds waiting to listen to her address filled the entire space from the door of the hall to the entrance to the ambulatory. Some stood on or in front of the platform, and others filled the aisles right up to the walls. 'Seldom, perhaps, has the hall been so full', remarked the reporter for the daily newspaper *Het Utrechts Dagblad* after her public lecture.[56] 'Even though the subject will not have possessed intrinsic interest to all those present.'

Immediately after her appointment was published in the Government Gazette (*Staatscourant*) of 8 January 1917, several weeklies opened with a portrait of the new professor. None had failed to note the remarkable nature of the event. 'So Dr Johanna Westerdijk has become the country's first woman professor', the periodical *Eigen Haard* reported, as though she were the winner of a contest that had been set many years before.[57] She is not an 'agitated, neurotic or complicated woman', the newspaper *Nieuwe Courant* informed its readers, with evident surprise.[58] On the contrary – 'young, and with a pleasant manner', was the verdict of *De Amsterdammer*.[59] One writer described her as 'natural, simple, healthy, calm and level-headed', while another asserted that she was 'strong, even-tempered and attractive, with a good sense of humour.' This was not just Utrecht's first extraordinary professor of plant pathology – this was the first woman professor in the Netherlands.

[54] Ibid.

[55] Westerdijk to Went, 13 July 1916, archives of Westerdijk, MB, Leiden.

[56] *Utrechts Dagblad*, 10 February 1917, IIAV, archives of Westerdijk, no. 35.

[57] *Eigen Haard*, 20 January 1917, IIAV, archives of Westerdijk, no. 35.

[58] *Nieuwe Courant*, 12 January 1917, GAA, 'folio personendossiers J. Westerdijk'.

[59] *De Amsterdammer*, 13 January 1917, IIAV, archives of Westerdijk, no. 35.

That was the epithet that she would carry with her for the rest of her life, although her uniqueness was short-lived. In 1919, Tine Tammes – the same Tine Tammes who had been passed over twenty years earlier for the job of Ritzema Bos's assistant, precisely *because* of her sex – expanded the 'community' of female professors to two when she was appointed to the chair in genetics at the University of Groningen.[60] But it was the first woman who made the biggest impression; at least, on the press and university audience that assembled in full strength to hear her address.

The young professor herself seemed fairly unmoved by all the fuss. 'And let me congratulate you too, Professor Went!', wrote Westerdijk in reply to his telegram. 'The appointment caused you so much trouble and frustration! But first and foremost I am so delighted that I shall in future be able to work with you in your botanical environment.'[61]

Besides her regular work, Westerdijk would henceforth be lecturing at Utrecht University for one hour a week. But her wider range of activities and higher status actually exacerbated her sense of frustration rather than alleviating it. As a professor, she had the authority to supervise PhD students. She was a popular lecturer, and students were eager to prepare their PhD dissertations under her supervision. But the laboratory in Amsterdam did not have the space such students needed to conduct experimental research.

'I have only one workbench, and I have already given it to Marie Löhnis', she wrote at the beginning of 1919, when Went sounded her out about a student who was interested in a spell at the laboratory. 'Another person staying here on a full-time basis would make the house unliveable.'[62] The house was scarcely pleasant as it was. She had too little coal to heat the library, while the other rooms were filled with the fumes from the 'disgusting' fuel with which the caretaker fed the stoves. The fungi too needed an increasing amount of space. Westerdijk was possessed by an old fear she had confided to *De Nieuwe Amsterdammer* on her appointment: of finding herself trapped in 'solitary confinement' as 'the lady of Roemer Visscherstraat.'[63]

Then two events turned the tide within a short space of time. On 24 November 1917, Willie Commelin Scholten's mother died and with her, her branch of the Commelin family. The board of governors of the Willie Commelin

[60] See e.g. I.H. Stamhuis, 'A female contribution to early genetics: Tine Tammes and Mendel's laws for continuous characters', *Journal of the History of Biology*, 1995, pp. 495-531.
[61] Westerdijk to Went, 10 January 1917, archives of Westerdijk, MB, Leiden.
[62] Westerdijk to Went, 14 January 1919, archives of Westerdijk, MB, Leiden.
[63] *De Nieuwe Amsterdammer*, 20 January 1917, IIAV, archives of Westerdijk, no. 35.

Scholten Phytopathology Laboratory convened a meeting within two months of her death.[64]

New solutions were agreed so quickly that it seemed as though everyone had been waiting for this moment. The board began by discussing the financial situation: Mrs Scholten had bequeathed to the Foundation invested capital of 100,000 guilders, yielding 2.5 % interest, in addition to 200,000 guilders in cash, all of it exempt from inheritance tax. The house had not been left to the Foundation, but would be sold in the near future; the rental agreement would be cancelled at the end of April 1918.

The board soon decided to accept Went's proposal: to expand the Laboratory's working area to include the phytopathology of the tropics, and on this basis to seek contact with the Colonial Institute, which would hopefully provide enough space to build a new (modest-sized) laboratory. This new Laboratory would be responsible for making recommendations on colonial phytopathology, providing opportunities for phytopathologists to do practical work, and promoting training in colonial phytopathology. Westerdijk had already drawn up a 'simple plan' that did not include lecture halls or classrooms, for which she was counting on the cooperation of the University of Amsterdam. Her plan came with a price ticket of 60,000 guilders.

The meeting decided that Went would communicate these intentions to the Colonial Institute, Westerdijk would conduct the negotiations when the time came, and the board member Professor Eduard Verschaffelt (who had been professor of pharmacognosy and plant physiology at the University of Amsterdam since 1896) undertook, as the minutes record, 'to approach Dr Delprat of the board of governors to discuss the Laboratory's relationship to the University in the context of the new plans, and to broach to Professor De Meyere the idea of the Laboratory sharing premises with his department of entomology.'[65] For the time being, the Laboratory would purchase the house at Roemer Visscherstraat and remain there.

The second event was the 70th birthday of Hugo de Vries on 16 February 1918, when the letter to the Colonial Institute had only just been despatched.[66] The great scholar had increasingly withdrawn to the seclusion of his estate in Lunteren over the past few years. Wizened and white-haired, and in frail health, he nonetheless still pulled the faculty's strings.

De Vries had of course long set the stage for his own succession. His protégé Theo Stomps, whose appointment as extraordinary professor of plant

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[64] On 18 January 1918, two months before the annual board meeting was scheduled, NWCS I, archives of the WCS.

[65] NWCS I, archives of the WCS.

[66] Bestuur WCS to KI, 8 February 1918, IIAV, archives of Westerdijk, no. 4.

taxonomy he had orchestrated in 1910, was to be given a full professorship. As for his own duties, there was only one man fit to take over them, he wrote. Quite simply: 'My basic assumption is that it is of the utmost importance for our Faculty to uphold its position in this discipline as in others, and therefore to offer the professorship to the person universally regarded by Dutch botanists as the most suitable candidate. Messrs Beyerinck and Moll both being ineligible on account of their advanced years, the appointment should go to Professor Went.'[67]

It is the language of someone who is accustomed to being obeyed. But this time, the faculty's biology department (consisting of the professors of botany, zoology and geology) was inclined to take a different view. In a letter running to four sheets of paper, it explained why it wished De Vries's professorship to be split up and assigned to *four* different people: Theo Stomps for plant anatomy and taxonomy (in line with De Vries's wishes); Eduard Verschaffelt, whom the department wished to appoint as Director of the Botanical Gardens (Hortus Botanicus) in addition to his existing professorial duties; J.C.H. de Meyere for genetics and applied zoology (he would thus acquire a full professorship instead of his existing part-time position); and, as a bolt from the blue, Johanna Westerdijk, as extraordinary professor of phytopathology.[68]

'For the faculty believes that the time has come to regulate the teaching of plant diseases, from both the botanical and the zoological side,' wrote the intrepid gentlemen of the biology department. 'This is the ideal time to do so. The Willie Commelin Scholten Phytopathology Laboratory in this city, having acquired a substantial inheritance after the death of Mrs Scholten, wishes to expand its working area. It has approached the Colonial Institute with a view to joint operations, the aim being to serve the needs of biologists working on agriculture in the East Indies, and to the same end it is willing to widen the opportunities for our students to learn about plant diseases. We feel strongly that this opportunity should not be allowed to pass, since our colleague De Meyere and the current director of the Phytopathology Laboratory, Dr Johanna Westerdijk, could both instruct our students, one on animal pests and ways of controlling them, and the other on plant parasites, thus complementing each other's teaching in the most efficient way.'

Did Went know about this? Did Westerdijk know? And what lay behind this remarkable proposal? It must be said straight away that De Vries's succession is something of a digression here, being only tangentially related to the history of the Willie Commelin Scholten Phytopathology Laboratory. But

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67 Hugo de Vries to FWN, UVA, April 1918, GAA 1020, inv. no. 200.
68 SB to FWN, May 1918, GAA 1020, inv. no. 200.

the numerous documents regarding this matter, which for reasons that are unclear have become dispersed among several different archives – and in one archive are even split up, being stored under different headwords – allude to a number of points and episodes that are relevant to this narrative.

First of all, by unflinchingly placing Westerdijk on their list of nominees, the faculty embroiled her in an extremely complex power struggle; one in which she could scarcely exercise any influence, and in which she was scarcely a serious participant.

It is questionable whether Westerdijk actually wanted a chair in Amsterdam. It appears rather too much of a coincidence that she should have been nominated so eagerly at this precise moment in time, after years of being virtually ignored by the local university, now that the Laboratory had acquired a 'substantial inheritance' (as the faculty itself noted drily). Moreover, her possibly anticipated role as 'small change' to be surrendered in the efforts to safeguard or improve the positions of the incumbent professors was so transparent as to deprive the nomination of all credibility – at least, that was how Westerdijk herself expressed it, with barely disguised scorn. 'How entertaining it is that everything is always done in this world for some ulterior motive, and not for the matter at hand', she wrote to Went.[69]

Even if she had in fact wanted a chair in Amsterdam – after all, the Willie Commelin Scholten Phytopathology Laboratory Foundation had long-standing ties with the University, and the Laboratory itself had its premises in Amsterdam, not in Utrecht, it is questionable she could ever have expressed her own conditions and preferences without incurring suspicions of strategic machinations in relation to the other titans involved in this struggle.[70]

Besides all this: would she ever have been willing to give up her professorship in Utrecht, in Went's so highly esteemed 'botanical environment', for what was to her a semi-professorship – since it would be solely related to plant parasites – while botany was doomed (in her eyes) to remain a 'weak' discipline after De Vries's departure?[71] 'I said that I had no intention of leaving Utrecht', she wrote to Went, at the end of May 1918.[72] 'Botany is going to rack and ruin here.'[73]

[69] Westerdijk to Went, 30 May 1918, archives of Westerdijk, MB, Leiden.

[70] 'I have always hated having my name linked to this succession', she wrote to Went on a Thursday, undated, in August 1918. 'Any anyway, I said straight away that I would only want to deal with phytopathology and not with general botany…. I have become a sort of cork to stop up all sorts of possible volcanic [eruptions].' archives of Westerdijk, MB, Leiden.

[71] Westerdijk to Went, 6 June 1918, archives of Westerdijk, MB, Leiden.

[72] Westerdijk to Went, 30 May 1918, archives of Westerdijk, MB, Leiden.

[73] Westerdijk to Went, undated, August 1918, archives of Westerdijk, MB, Leiden.

Even so, the faculty calmly maintained in a recommendation to the board of governors in mid-June that there would be 'no objection to Westerdijk being appointed to such a position in Amsterdam, given her light responsibilities at the university in Utrecht … We are also persuaded that Miss Westerdijk herself regards these duties as merely temporary'[74] – although two weeks later they quickly changed their tune: 'The position of our faculty may be summarized as follows, that it has no objection to Miss Westerdijk continuing to give her current lectures in Utrecht after being appointed as extraordinary professor here, should she wish to do so, though in such a form that she would no longer be a member of the Utrecht Senate.'[75] But as an extraordinary (i.e. part-time) professor, Westerdijk was not a member of Utrecht's university senate anyway; she was a mere auditor at their meetings.

The question arises as to Went's role in all these plans. Given their background, it seems fair to conjecture that De Vries and Went may well have orchestrated the entire plan together behind the scenes, but given the lack of documentation, only a few points can be established with any certainty.

In all probability, De Vries continued to insist on his own proposal and hence opposed the nomination of Westerdijk and the other candidates. Westerdijk suspected as much at an early stage in the proceedings. 'De Vries too can be assumed to be against it, so I do not think the matter will be resolved', she informed Went later on. 'I have the impression that the biologists will suggest giving Stomps a full professorship and not appointing anyone new [i.e. not Went, as De Vries had wanted], but they are prepared for De Vries intervening in any way he chooses.'[76]

She was subsequently indignant when De Vries failed to show up for the first and most important faculty meeting. 'The noble crusader De Vries did not appear in the arena, of course, but stayed on his estate', she said derisively to Went.[77] But what had she expected? She herself was pulled in two directions: she agreed with De Vries in supporting Went's appointment, but that meant opposing the department's proposal, including her own nomination.

Went must have played a crucial role in the resolution of this dispute, but no letters written by him in this period have been preserved in the archives. This much is clear: Went remained a professor in Utrecht until his retirement in 1934. It is questionable whether he ever even considered transferring to Amsterdam: but his ego must have been flattered when a large group of

[74] FWN to CC, 12 June 1918, GAA 279, inv. 68, bijlagen bij notulen College van Curatoren 71.
[75] FWN to CC, 29 June 1918, GAA 1020, inv. no. 200.
[76] Westerdijk to Went, 30 May 1918, archives of Westerdijk, MB, Leiden.
[77] Westerdijk to Went, 6 June 1918, archives of Westerdijk, MB, Leiden.

Amsterdam students set up a petition, after De Vries's departure in the summer of 1918, demanding the appointment of a 'strong personality' such as himself – and therefore rejecting the department's proposal.[78]

The students' petition intensified a crisis of conscience that Westerdijk had been trying for some time to assiduously disregard: to sign it would be a gesture of solidarity with Went ('my fingers itched to sign that piece of paper'), but this would render her own nomination null and void – something she would in fact have been happy to do, 'but it seemed to me that I could not disqualify myself, in the interests of the WCS. It would have rendered any link between the Laboratory and the University impossible for years. I also suspect that the board of the Laboratory would have considered it unforgivably foolish of me to sign. I fervently hope that the students get their way, in other words, that they get you to come here. This would bring down the other "corks" (Stomps, De Meyere and me), but that does not matter so much to me; I'll get in anyway in a few years' time, and the whole thing would be placed on a more stable basis.'[79] So she did not sign, and remained ostensibly a candidate for a chair – partly not to rock the boat during the negotiations with the Colonial Institute.

Went appears to have prevaricated for some time. In December 1918, the board of governors of the University of Amsterdam expressed a desire to appoint a 'heavyweight' such as Went or Schouten alongside Stomps, in line with De Vries's proposal. If Went had expressly opposed it at this stage, the board would not have snubbed the faculty by directly contravening its preference in this way.

The board's recommendation was submitted to Amsterdam city council (the responsible authority, since this was a municipal rather than state university) at the beginning of February 1919, and the council approved it in November 1919. Went had evidently withdrawn from the procedure by then. 'In our view, none of the scholars whose names have been put forward for the second chair is of such eminence as to make an appointment wholly desirable for our university's reputation', the board now maintained.[80]

They were back to square one. The board of governors too was now insisting on an appointment in line with the faculty's original recommendation, although it had somewhat toned down its support for De Meyere, and was still considering his position. This meant that Westerdijk was in the running again. The board of governors thought it best to await the outcome of the negotiations with the Colonial Institute.[81]

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78 Documents relating to the student campaign can be found in GAA 279, inv. nos. 71-71.

79 Westerdijk to Went, undated, August 1918, archives of Westerdijk, MB, Leiden.

80 CC to GR, 19 November 1919, GAA 279, inv. nos. 71-71.

81 Ibid.

These negotiations had now been going on for weeks. At the request of the burgomaster of Amsterdam, Westerdijk had sketched the contours of a new Willie Commelin Scholten Phytopathology Laboratory on the plans of the Colonial Institute – adding, however, that the surrounding ground was unsuitable for use as an experimental garden 'because of the high trees on several sides.'[82]

What she did not state explicitly was that she positively disliked the prospect of having to move to the Colonial Institute. An experimental plot outside the city, at the Linnaeus garden complex, would be useful, but its distance from the new laboratory would be a problem, 'considering how short-staffed I am.' At Westerdijk's own request, her appointment as extraordinary professor of plant pathology at the University of Amsterdam was then deferred. She considered it 'made little sense to start on lectures and laboratory classes before the new Laboratory [had] been properly set up.'[83]

On 15 May 1920, Went observed at a WCS board meeting that the Laboratory's relations with the University of Amsterdam were 'up in the air', since it was unclear whether the University was interested in forging closer ties. 'Given the difficulty of finding a suitable plot of ground for experiments in Amsterdam (which is also impossible to achieve at the Colonial Institute), one might wish to consider the possibility of using Canton Park in Baarn, which has been bequeathed to Utrecht University. If the Laboratory could be moved there, it might benefit students from both Amsterdam and Utrecht. The question of who should be entrusted with the construction work, and how best to consolidate the capital, must be looked at more closely.'[84]

Westerdijk had got to know Canton Park well since her appointment at Utrecht University. 'This garden is all smiles', she exulted in the daily newspaper *Nieuwe Rotterdamschen Courant* about the park and its almost unlimited scope for botanical education: 'the plants, because they have such a wonderful habitat, the lovely friendly little corners with delicate colour combinations; it is as if life with all its allures and surprises is smiling on us, and we ourselves smile to see how splendidly we are being led through and around the garden.'[85]

At the end of July 1920, she saw a poster advertising the sale at auction of Villa Java, the mansion opposite the park. She hurriedly convened a WCS board meeting. 'It was now or never, I thought', she wrote to her former assistant

[82] Westerdijk to Tellegen (burgomaster of Amsterdam and president of the CC), 11 October 1919, GAA 279, inv. nos. 76-278.

[83] NWCS I, 31st meeting, 24 October 1919, archives of the WCS.

[84] NWCS I, 32nd meeting, 15 May 1920, archives of the WCS.

[85] Quoted in M.P. Löhnis, *Johanna Westerdijk: een markante persoonlijkheid*, Wageningen, 1963, p. 30.

Lucy Doyer.[86] 'It became a kind of fever! Instead of going to Berlin the following Tuesday, I visited one board member after another, and persuaded them to meet one afternoon in Canton. All their doubts evaporated as if by magic! The Java Villa had to be procured at all costs! Our finances are not in the best possible state, but we need to be a little intrepid. On Thursday 5 August, Spakler and I were sitting anxiously behind the door of the auction-house when the house came under the hammer. With this awful system, a house could so easily slip through your fingers. But we got it! I am so happy! I had not viewed the house beforehand, for fear of driving the price up. 'People' always said that house would never be sold! But it is even more suitable than I had thought beforehand!'

The Willie Commelin Scholten Phytopathology Laboratory Foundation purchased Villa Java for 80,000 guilders in August 1920. Westerdijk was ecstatic. 'It will transform the way we work,' she wrote to Doyer. 'I have been here [in Berlin, with Otto Appel] for some two weeks now, for a mental boost, and then we shall quickly set about changing the house and moving in. … I am going to change the vegetable garden facing Canton into a garden for diseased specimens: at Java we shall conduct our own experiments…. I shall often be nagging you to give us diseased seed. What luxury!' She rattles away like this for much of her letter, full of plans and fantasies for the future. *En passant* she also reveals one of the primary reasons for her joy – 'And I am rid of the nightmare of the University of Amsterdam!'[87]

Meanwhile, the news had stunned Amsterdam, provoking a furious outburst. 'Your notification cannot be entirely cleared of the charge of sarcasm', wrote Dr C. Delprat. He was a member of the university's board of governors, but his letter was written in a personal capacity. 'That the board did not send the said notification until 11 October, in other words until everything had been settled, indicates that the board itself was conscious that its actions were not entirely beyond reproach, and sought to bolster its position by confronting us with a *fait accompli*.'[88]

His letter went on to stress that the Phytopathology Laboratory had been founded by people from Amsterdam, in memory of an Amsterdam student, and placed at the service of the University of Amsterdam – its annual report had to be submitted to the board of governors of the University of Amsterdam, or to Amsterdam's municipal executive – the director was required to live in Amsterdam – the director was answerable to, and had to submit her accounts

86 Ibid., pp. 32-34.
87 Ibid., p. 34.
88 Delprat to Bestuur WCS, 24 October 1920, GAA 279, inv. nos. 76-278.

to, the board of governors of the University of Amsterdam, or to Amsterdam's municipal executive – the Laboratory was intended for Amsterdam. Every 'Amsterdam' in his letter was heavily underlined, so that the word practically jumps off the page.

Suddenly moving a Laboratory that was intended for Amsterdam to the surroundings of Utrecht, in the knowledge that efforts had been underway for eighteen months to provide good facilities for research and education in Amsterdam, and to reserve a professorship for the Laboratory's director – *at her own request*: it was 'not an edifying spectacle', and one that would have made the Laboratory's founders turn in their graves.

Went sought to calm the frayed tempers in the longest letter he ever wrote – at least, the longest in the archives. He reviewed the entire history of the Willie Commelin Scholten Phytopathology Laboratory, explained why Ritzema Bos's departure had been a relief, why Westerdijk's appointment had completely restored confidence in the Laboratory, why he was particularly eager that phytopathology teaching should be resumed, and why the conditions in the house in Amsterdam made the situation untenable there. The board of the WCS had a positive obligation to move to Baarn, he declared. In conclusion, he said that the new institute would be of great benefit to the University of Amsterdam, and then, with a venomous parting shot, 'notwithstanding the fact that Amsterdam has never lifted a finger to help the Laboratory.'[89]

The University of Amsterdam had no alternative but to give its grudging acquiescence. It was true that the WCS would be better off in Baarn, agreed Professor Verschaffelt, who had been joining in the discussion with two hats on all this time. But he hastened to say that no blame whatsoever attached to the faculty![90]

By this time, Stomps had indeed been appointed – in accordance with De Vries's original recommendations and those of the biology department – as full professor of plant taxonomy. Verschaffelt had become director of the Botanical Gardens ('Hortus'). De Meyere's part-time position was about to be converted into a full professorship. But Westerdijk's chair disappeared from the agenda without a ripple.

89 Went to Delprat, 1 February 1921, GAA 279, inv. nos. 76-278.

90 Verschaffelt to Went, 9 February 1921, GAA 279, inv. nos. 76-278

4 ‘Out in Baarn’

Westerdijk was just thirty-four when she gave her inaugural address in Utrecht. One of the photographs taken on this occasion shows her in a static pose, standing beside a column. She is wearing a black gown and has a book in her left hand. A white jabot dangles below her chin, and her flat black beret is stuck upright on her head. She gazes earnestly into the camera, her eyes hidden as always behind the thick lenses of her glasses. It is a stately portrait, so dark that her face and jabot provide the only highlights. The picture exudes gravity, a consciousness that history was being made.

Her students took a slightly different view. After the ceremony they ascribed the following lines to her in a musical:

‘In my black tent I bring to mind
A laundry basket from ancient times.’

Westerdijk laughed good-humouredly.

Her appearance changed little over the years. Anyone who leafs through a few of the photographs in the International Information Centre and Archives for the Women’s Movement will easily pick out the ‘Lady Professor’ even in a large group of people, not only on account of her appearance – an ample figure in a tent dress, thick glasses pinching her nose, heavy chin and plump cheeks, resolute bottom lip – but also because of her position and forceful gaze. If Villa Java was the setting for academic phytopathology, Westerdijk, whether in radiant or earnest mood always a strong presence, was its absolute centre.

She was also a woman in a world that had hitherto been dominated by men. Countless stories highlight this anomaly. At the first professorial social event she attended, Westerdijk was reported to have ostentatiously lit a large cigar, prompting one of her male colleagues to slap her heartily on the back, exclaiming words to the effect of ‘Hallo old chap, how’s life?’[1] In a cigar-less

[1] V.J. Koningsberger, ‘Persoonlijke herinneringen aan Johanna Westerdijk’, in M.P. Löhnis, *Johanna Westerdijk, een markante persoonlijkheid*, Wageningen, 1963, pp. 78-82, esp. p. 79.

Inaugural address given by Westerdijk at Utrecht University, 1917. International Information Centre and Archives for the Women's Movement.

version of this story, Westerdijk was welcomed with the equally absurd 'How do, old girl!'[2]

Anecdotes frequently cite her booming laugh, her love of parties, drinking and dancing, her distaste for marriage and other pointless conventions, her short-sightedness, and her expressive eyes, whether mocking, interested, or full of sympathy. 'When she wanted to test our progress, she liked to take us somewhere like the back room of the fancy bakery in Nieuwstraat. As we sat there, surrounded by fashionable ladies daintily picking at their cakes with a fork, she would suddenly demand, 'OK, now what can you tell me about yellow disease

[2] M. Bosch, *Het geslacht van de wetenschap. Vrouwen en hoger onderwijs in Nederland 1878-1948*, Amsterdam, Socialistische Uitgeverij Amsterdam (SUA) 1994, p. 391.

in hyacinths and the slime it produces?' With the emphasis on *slime*, you understand?'[3] Her lectures were lively and inspiring, former students recall. 'Very different from the tedious reading out of notes that most professors relied on in those days.'[4]

'The first time that the voice of a woman professor sounded in that historic space, it immediately sounded right', the *Utrechts Dagblad* agreed after her address. 'The sonorous, robust voice with its clear articulation reached the furthest corners of the hall.'[5] The members of the audience had therefore left the hall with Westerdijk's message ringing in their ears.

'A phytopathological study, [conveying] knowledge of a disease and the way to fight it, must be based on an understanding of the physiology of both the host plant and the parasite', she had told her listeners.[6] 'Many researchers from the beginning of this century and the end of the last focused too heavily … on studying the parasitical organisms and neglected the pathology of the host.'

Today's phytopathologist, she went on, faced a great many complex problems. It no longer sufficed to have an understanding of the fungi in their dried state: 'as opposed to the fixed morphology of conserved material, phytopathologists study the mutability of pure culture.'[7] And as far as the pathology of the host was concerned: 'There is an urgent need for a real textbook of pathology, which emphasizes symptoms and classifies them in groups. … What is needed is a more rational classification of groups of diseases, based on a better understanding of the development of the disease and [the plant's] anatomical structure.'[8]

The subject of immunity must have priority, she insisted. It was an eternal, vexing question: why did one plant become diseased and not another? Do certain chemicals attract fungi? Are plants only susceptible to parasites at a particular stage of their development? Is it a matter of chemistry? Or anatomy? What part is played by external conditions? 'Anatomical and physiological studies of the host plant, changes that take place in the plants under cultivation under the influence of different conditions, examined in the light of the ability of the parasites to induce infection, all these factors together should constitute the foundations of the concept of immunity in the plant

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[3] Interview with Dr Johanna Went in Arnhem on 23 May 1991.

[4] Personal communication Jan Carel Zadoks.

[5] *Utrechts Dagblad*, 10 February 1917, IIAV, archives of Westerdijk, no. 35.

[6] J. Westerdijk, *De nieuwe wegen van het phytopathologisch onderzoek*, ('The new avenues of phytopathological research'), inaugural address at Utrecht University, 1917, pp. 9-10.

[7] Ibid., p. 13.

[8] Ibid., p. 17.

kingdom. Basing ourselves on the fruitful conclusions of the latest experimental genetics, it should be possible to deliberately cultivate resistant plant varieties in the future.'[9]

In conclusion, the new professor noted that the return of phytopathology to the university meant that these questions could be studied and taught seriously and in a rigorously scientific way. As far as she was aware, throughout Europe the subject was taught at colleges of agriculture; only in the United States could it be studied at almost all universities.[10] The introduction of this discipline at Utrecht University placed a grave responsibility on her shoulders, she said, adding – thrusting out her chin – that this responsibility provided an extra imperative for her to fulfil that responsibility to the best of her abilities.

She closed to enthusiastic applause. Later that evening, the women students of the university lit torches at Domplein. Holding them up ablaze, they formed a procession to Westerdijk's hotel and serenaded her. To their indescribable delight, Westerdijk came out to greet them in person. From her balcony she yodelled to the girls in the conflagration, and then waved to them, as if she had been crowned queen. Despite this triumph, however, it was not her appointment to the professorship in Utrecht, but the move of her laboratory to Baarn, that finally gave Westerdijk the space, quite literally, to fulfil her task as she saw fit.

Diseased elms

Dina Spierenburg had been working at the Plant Protection Service in Wageningen for just two years when she published a short article on elm disease. This article, 'Een onbekende ziekte in de iepen' ('An unknown disease in elms'), Communication 18 issued by the Plant Protection Service in January 1921, was classified in retrospect as the beginning of a remarkable series of events, which aroused public consternation, galvanized the phytopathologists in Wageningen and Baarn, and at length led to a collaborative venture of such size and efficiency that the disease – which, like any infectious disease, pays no regard to regional or national borders – became known internationally as Dutch elm disease. And this name, in contrast to the other common connotations of 'Dutch' in the Anglo-Saxon tradition, is a compliment, write the compilers of *Dutch Elm Disease: The Early Papers, Selected Works of*

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9 Ibid., p. 25.

10 For the differences between the situation in the Netherlands and that in the United States, see also M.W. Rossiter, *The emergence of agricultural science: Justus Leibig and the Americans 1840-1880*, Yale, Yale UP, 1975; C.S.L. Grantham (ed.), *Agrarian organization in the century of industrialization: Europe, Russia and North America*, JAI Press, 1989.

Seven Dutch Women Phytopathologists, which ascribes a crucial role to these seven women scientists.

The elms in the Netherlands are diseased, wrote Spierenburg, after the Plant Protection Service in Wageningen had received diseased elm twigs from all parts of the country in 1919-1920. How long the disease had been rampant was hard to say. Perhaps it had arrived years before but had gone unnoticed because of the First World War. Or perhaps it was a completely new phenomenon.

The cause was also a mystery, although there was no shortage of suggestions. It was caused by gas from underground pipes in the Netherlands. It was caused by combustion gases from a certain type of coal. Elms growing at the side of streets that had recently been raised looked sicker. Elms growing at the side of streets that had recently been raised looked less sick. Trees that flowered profusely were more diseased than others. Trees that flowered profusely were less diseased than others. Meanwhile, members of the public sent vast numbers of dead beetles to Wageningen, where they were identified as *Scolytus scolytus* F., the large elm bark beetle.

But the plain truth of the matter, wrote Spierenburg in January 1921, was that very little was known about the disease as yet. A diseased tree-trunk exhibited a brown discoloration in the outside growth rings. Young leaves in the crowns of trees that otherwise looked perfectly healthy were wilting and dying. The roots of some trees were found to be completely rotten. In a few dead trees, hundreds of beetles were discovered to be living in an extensive network of tunnels or 'galleries.' A variety of fungi could be isolated from diseased material. But whether the actual cause of the disease was a fungus, or the beetle, or the soil, or perhaps the extremely hard frost of 1917, or the long, hot summer of 1918, was unclear: 'We do not know the syndrome.'

'This year we shall examine accurately the entire disease process yet again', she concluded, 'and await the results of the infection experiments. If these do not succeed, then we shall have to repeat them annually under other conditions, on different dates, etc., which can become a very prolonged investigation. … The elms that are now diseased do not profit from that research at the moment, and if the disease does not disappear again in the same inexplicable way in which it showed up, I fear that the trees will go downhill farther, and will finally die.'[11]

[11] 'Barendina Gerarda Spierenburg, 1880-1967', in F.W. Holmes and H.M. Heybroek, *Dutch Elm Disease: The Early Papers, Selected Works of Seven Dutch Women Phytopathologists*, APS Press, 1990, pp. 9-18, esp. pp. 17-18.

The disease did not disappear as abruptly as it had arrived. On the contrary, as 1921 went on, the Plant Protection Service continued to be deluged by diseased elm twigs, leaves, trunks, and beetles, besides a mountain of correspondence. Spierenburg and her colleagues at the Service, T.A.C. Schroevers and N. van Poeteren, travelled all over the country examining the damage, and with the aid of their observations and those of the many correspondents, Spierenburg charted the dissemination of the disease.

It was certainly an alarming picture. In the province of North Brabant, the disease raged wherever elms were to be found. In the Betuwe region, a serious outbreak had been reported. The worst outbreak of all was in Rotterdam and the surrounding area. In North Holland, the disease had spread as far north as Alkmaar. Diseased elms had also been found in Amsterdam. The south of the country appeared to have been affected more seriously than the north, but this observation could have been distorted by the fact that there were simply more elms in the southern regions. Basically, the disease was everywhere. Spierenburg had even found a diseased elm as far north as Friesland.

The Plant Protection Service wrote to foreign tree experts and soon established that the new elm disease had also taken hold in France, Belgium and probably Germany. Denmark, Sweden and the United Kingdom appeared to be free from the disease as yet, but this information was of questionable reliability, given the specialist skill needed for a diagnosis.

The cause was still unknown, and speculation was rife in the popular press and trade journals. A French scientist suggested that the elms were suffering from the effects of poison gas used in the war. A similar hypothesis, emanating from Limburg, held that the elms were succumbing to disease precisely along streets that had recently been raised using sand from the Maas, which flowed right through the war zone. Some blamed subsidence triggered by mining operations. Others blamed dangling electricity cables; the products of incomplete combustion in exhaust fumes from motor vehicles; putting salt down on icy roads. Everything that was modern, new, unfamiliar or undesirable might be to blame. One writer even turned a suspicious eye towards working-class women: were they not throwing the salty water in which they had boiled their potatoes directly into the street?

It was a mystery, sighed Spierenburg, why so many people who had not the slightest experience of silviculture, horticulture or agriculture and knew nothing about plants or trees, let alone about plant diseases, were happy to trot out their own private views of this disease. Perhaps it was because elms were real town trees, and attracted attention. Perhaps it was because everyone now knew there was something wrong with elms. One thing was certain: never before had a plant disease attracted so much attention from so many ignorant laymen, who were together spouting so much utter nonsense.

That the stricken elms had generated such a commotion was certainly not attributable solely to the country-wide spread of the disease. An elm was not just a tree, an elm was a symbol, a totem of aesthetics and the economy wrapped into one. In Westerdijk's words, elms touched 'a tender spot in the Dutch national soul.'[12] Even today, the elm is a quintessentially Dutch tree. It grows fairly rapidly, and has a resilience that makes it a popular sight in the windblown low countries. 'Elms like a cold, briny sea breeze', as one reporter put it in the weekly magazine *Vrij Nederland*. 'They don't mind acid rain. They love exhaust fumes. And besides all this, they are beautiful. They will cheerfully grow in spots disdained by flimsier trees. By canals. Next to village churches. Or triumphantly atop the ramparts of an old fortified town. Of all trees, the elm is the most characteristic Dutch city-dweller, and a Jewel of the Polder besides.'[13] From the dikes of Zeeland to the green meadows of Holland, elms gave the typically Dutch landscape the charm that had made it famous around the world.

How serious was the disease? Was there a remedy for it? 'The disease occurs in cities, in villages, along streets, on squares, in parks, in municipal ornament plantings, along dikes and national highways, on clay soil, peat soil, in wet places, in dry places; in one word, everywhere that elms grow individuals affected by the *unknown elm disease* occur', wrote Spierenburg in January 1922, printing the name of the disease in italics as if trying to exorcise it.

It had proved possible to isolate fungi and bacteria from the dark-coloured rings. But neither these nor the elms themselves were new to the Netherlands: so why should the elms suddenly be succumbing to fungal or bacterial disease? 'In our opinion, even if we should be dealing at the moment with a fungal or bacterial disease, an external influence [with] a generalized effect must still have made the trees susceptible to the fungal or bacterial infection', Spierenburg concluded. And for her final sentence she again resorted to italics: '*It is questionable whether we shall ever succeed in discovering this generally working influence.*'

As far as the description of elm disease as a syndrome was concerned, Westerdijk later pronounced, Spierenburg was well informed and her observations were lucid. But the 'culturing' part of her work, the procedure she had followed for isolating and classifying the fungi and bacteria from the wood, was 'flawed.'[14] And it was in this precise area that the Willie Commelin Scholten Phytopathology Laboratory was unrivalled by any other institute of phytopathology in the Netherlands – perhaps in the world.

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[12] J. Westerdijk and C. Buisman, *De Iepenziekte, rapport over het onderzoek verricht op verzoek van de Nederlandsche Heidemaatschappij*, 1929, p. 3.
[13] G. van Westerloo in the weekly *Vrij Nederland*, 25 November 1995.
[14] J. Westerdijk and C. Buisman *De Iepenziekte, rapport over het onderzoek verricht op verzoek van de Nederlandsche Heidemaatschappij*, 1929, p. 4; paraphrase of Westerdijk's words.

In splendid isolation

Bea Schwarz and Maria Löhnis were Westerdijk's first two PhD students. Maria Löhnis – the daughter of the former board member F.B. Löhnis, inspector of agriculture education – had been working with Westerdijk since 1913, when the laboratory was still in Amsterdam. 'I myself remember so clearly when she told me about it [the move to Baarn] in utter confidentiality, and how delightful I found the prospect of working out in Baarn', she later wrote, in an affectionate portrait of her old mentor.[15] Baarn was in the countryside – far away from the confines of the city, and from the sense of gloom that clung to the tragic Commelin Scholten family and its laboratory.

Amsterdam's municipal archives contain a photograph of the Villa: a light, symmetrical structure designed in nineteenth-century colonial style, with high windows and ceilings, stained-glass windows, and a spacious glass conservatory. In the photograph it has an elegant, rather distinguished air about it,

Postcard with view of Villa Java, Baarn, c. 1925. Archives of the WCS, Haarlem.

[15] M.P. Löhnis, *Johanna Westerdijk, een markante persoonlijkheid*, Wageningen, 1963, p. 34.

partly because it stands alone at the end of a driveway, without a trace of other buildings in the vicinity.

'The idea of living *buiten* thrills me', Westerdijk had written to her friend Lucy Doyer. *Buiten* means 'in the countryside', but it also means 'outside' – out of town, and outside the more controlled urban environment. There, on the park-like outskirts of the smallish, largely Catholic town of Baarn, with Utrecht University's Canton Park within walking distance, Villa Java was both literally and figuratively a sanctuary of science.

Phytopathology was an optional subject. No one was compelled to study it, let alone gain a PhD in it. The subject's unattached status in the University Statute made it possible for Westerdijk and her students to live and work 'in splendid isolation' from both the hectic atmosphere of the University of Amsterdam and the earnestness of Went's biology course in Utrecht. Space permitting, anyone wanting to work in the Villa was welcome to do so.

Geese, peacocks and ducks scurried about the yard in lieu of guard-dogs. 'In a separate wing at the top, right on the sunny side with bay windows from which you can see the tower in Amersfoort' was Westerdijk's own apartment.[16] Facing east was a modest-sized apartment where the Eggerts lived. Marie Eggerts was the caretaker and cooked for 'the Professor'. There was a small room for lab work, a large kitchen for making fungi culture media, and a stable with a coach house, which was to become the home of the permanent assistant Van Luyk.

Unimpeded by ingrained ceremonial rituals – in fact unimpeded by the physical presence of colleagues, let alone the stifling constraints of invisible hierarchies or expectations, Westerdijk created her own traditions – traditions that have since become legendary. When her first student gained a PhD, the flag was hoisted, and three geese wearing white, red and blue bows round their necks paraded around the building. At every new PhD ceremony, the young doctor and his or her supervising professor would plant a tree in the one-and-a-half hectare garden in which the Villa stood: a 'doctor's tree' in what became known as the Doctors' Wood. The evening would be filled with the sounds of piano music, singing and laughter. The content of the thesis would be recapitulated in rhyming couplets, as if in a fresh demonstration of competence, this time in self-mockery and self-irony, the motto being 'If you can't play the fool, how can you ever be serious?'[17]

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[16] M.P. Löhnis, *Johanna Westerdijk, een markante persoonlijkheid*, Wageningen, 1963, p. 34.

[17] '[W]ant als men de malligheid niet ziet, wat ziet men dan van het echt?' from the text of a poem, 'Wat Tyl Uilenspiegel vertelde en er heden aan toevoegt', 22 November 1952, IIAV, archives of Westerdijk, no. 66.

It must have all been rather baffling for the locals. The Villa had stood vacant for years. Now there was a sign at the beginning of the drive proclaiming the Willie Commelin Scholten Phytopathology Laboratory and the Central Bureau of Fungal Cultures; young ladies and gentlemen evidently pursued science here. Yet now and then the entire building was lit up, and the respectable ladies and gentlemen danced until the small hours. And what exactly did the young people get up to with those test tubes in the daytime?

The chemist in Boschstraat said he could pick out the foreign visitors at Villa Java at a glance, by their clothes. Westerdijk treated the major international phytopathology conference of 1923 to a festive reception, followed by a Punch and Judy show, in which the puppets fired questions at the flabbergasted visitors.[18] 'Having to answer questions about "the seven different viral diseases that may afflict the potato" was an embarrassing experience for many a foreign phytopathologist', recalled Löhnis, with mildly malicious delight.[19]

It has all been preserved at the IIAV: the piles of paper, file after file of texts and rhyming couplets, silent witnesses to the once so famous parties at Villa Java. Far from all of this material was written by Westerdijk. Maria Löhnis 'contributed a great deal to the success of the famous festivities in Baarn by writing witty verses in several languages,' wrote Bea Schwarz in an *In Memoriam* for Löhnis in 1964.[20]

During Westerdijk's term as director, the music will have struck up a total of 55 times in Baarn after the successful defence of a PhD thesis elsewhere. The doctorates went to 29 men and 26 women, in a period of 35 years. Proportionally speaking, Went delivered roughly the same number of PhDs in the 38 years of his professorship – and botany was a main subject at university.[21] All those who worked on their PhDs in Baarn, without exception, enthused about the atmosphere and the influence of the laboratory's slogan: 'For fine minds, the art is/To mix work and parties' ('Werken en feesten vormt schone geesten'), which Westerdijk had carved in stone above the entrance to the coach house named 'Madoera'.

In May 1921, the first university students arrived to do practical lab work in Baarn: six women and a man. They had attended a six-week course on fungi in

18 IIAV, archives of Westerdijk, no. 66; this was not the first international conference of phytopathology – at least, the organizers did not experience it as such. They referred, during their preparations, to the international conference of phytopathologists held in Rome in February 1914 and the International Potato Conference in London in November 1921. See 'De Voorlopige Commissie van voorbereiding aan de minister van Landbouw, Nijverheid en Handel', undated, 1921, Correspondence 1921, archives of the WCS.

19 M.P. Löhnis, *Johanna Westerdijk, een markante persoonlijkheid*, Wageningen, 1963, p. 36.

20 B. Schol-Schwarz, 'IM M.P. Löhnis', *Netherlands Journal of Plant Pathology*, vol. 71, 1965, p. 3.

21 A total of 63 students gained their PhDs under Went's supervision in this period (1896-1934).

Utrecht first, with Went, and followed it up with a six-week practical course in Baarn. Four of them (all women) decided afterwards that they wanted to start working on a PhD under Westerdijk's supervision.[22]

Bea Schwarz went first, on 4 April 1922, when she defended her thesis *Das Zweigsterben der Ulmen, Trauerweiden und Pfirsichbäume* ('Twig canker in elms, weeping willows and peach trees'). Three days later came Maria Löhnis with her *Onderzoek over Phytophthora infestans* (Mont.) de Bary *op de aardappelplant* ('Study of *Phytophthora infestans* (Mont.) de Bary on potato plants'). A photograph taken at the dinner held to celebrate Schwarz's doctorate shows radiant students flanking a beaming Westerdijk, with their mothers on the other side of the table gazing earnestly into the lens.

It was not initially the intention for Schwartz's thesis to include diseased elms, write the compilers of *Dutch Elm Disease: The Early Papers, Selected Works of Seven Dutch Women Phytopathologists*. She began by studying twig canker in weeping willows and peach trees. But since the elm disease broke out while she was doing her research, and since at first sight this disease resembled a form of twig canker, it seems that Westerdijk asked her to include elm disease while she was about it.

This reconstruction of events sounds perfectly plausible. It is true that in most cases Westerdijk herself determined the subjects of her PhD students' theses – frequently subjects that had been suggested to her by people working in the field. That was how Löhnis had ended up studying the cause of potato disease – which was initiated at the request of, and was largely financed by, the Research and Advisory Committee for Public Welfare and National Defence – and much the same probably applied to Schwarz's interest in twig canker in peach trees – aroused by an observation and a request for clarification by one A.W. Boerman, a former student of Westerdijk's, who had written to her about it in 1919.

Until well into the 1920s, growers, gardeners, teachers and concerned plant lovers all exercised a discernible influence on the PhD subjects researched at the Willie Commelin Scholten Phytopathology Laboratory. Aside from this, the fungus collection of the Central Bureau of Fungal Cultures also generated numerous questions that Westerdijk considered worthy of in-depth study in a PhD thesis. In the period up until 1928, these various studies resulted in twelve PhD theses. Only towards the end of the decade did a number of independent lines of research start to become clear, lines that were apparently inspired by purely scientific, phytopathological considerations.

[22] M. Kruseman started her PhD thesis, but never completed it – the other three were M.B. Schwarz (1922), P.C. Bolle (1924), and C.M. Doyer (1925).

In the summer of 1920, the director of Rotterdam's Parks and Public Gardens Department sent a number of diseased elm twigs to the Willie Commelin Scholten Phytopathology Laboratory. Schwarz agreed to widen her research to include elm disease, and took regular trips to Rotterdam to examine the syndrome for herself. The leaves were wilting, even though it had been an extremely rainy summer. So drought could be eliminated as a possible cause, she wrote in her thesis. She noted that the disease was worst in the elms near a gas factory. The peaty, acidic soil there was swampy and poorly ventilated. The roots of trees that were almost dead were found to be completely rotten.

Everyone thought that the disease was caused by something in the soil, wrote Schwarz. But this was inconsistent with the development of the brown discoloration in the wood, which spread from the crown to the roots. Since this discoloration was the primary anatomical symptom of the disease, the cause could not possibly lie in the soil. The disease was caused by something above, in the crown.

'All that remained was to try to ascertain whether some organism could be cultured from the discoloured wood', she concluded.[23] So she sterilized diseased fragments of wood and placed them in a petri dish filled with cherry agar. This led initially to the growth of a variety of fungi, primarily of the type *Fusarium*. But when she used the discoloured wood from the inside of the diseased tree instead of the discoloured ends of twigs, only a single fungus developed, one that was never found in the healthy wood. She repeated the isolation process many hundreds of times, and each time observed the growth of the same, unknown fungus. In this way, Bea Schwarz isolated *Graphium ulmi* nov. spec., or 'parasite on elm trees in many parts of the Netherlands.'[24]

Graphium ulmi turned out, like most fungi, to have distinct preferences: it thrived on culture media with potato, rice and cherries, but abhorred beer, oats and banana.[25] Only in a damp habitat did the fungus infect the leaves of the tree, as infection experiments demonstrated: so the elm mortalities of 1921, with its very dry summer, had not resulted directly from the fungi, as Schwarz set forth in her analysis, but from an earlier infection. As a result of the drought, the vessels that had already been attacked were now no longer capable of nourishing the tree's growth.

Infection experiments yielded the characteristic brown discoloration in the wood, but not the typical wilting of the leaves. Another anomaly was that in the experiments the discoloration spread both upwards and downwards,

[23] B. Schwarz, *Das Zweigsterben der Ulmen, Trauerweiden und Pfirsichbäume*, PhD thesis Utrecht, 1922, p. 10.
[24] Ibid., p. 14.
[25] Ibid., p. 17.

whereas in the natural situation it spread only from above to below.[26] One possible explanation for this, Schwarz suggested, was that she had only injected *Graphium* into cuttings (generally speaking, it is almost impossible for cuttings to become diseased spontaneously) and an alternative explanation was that in her experiments the weather conditions differed too greatly from those in which the disease occurred naturally.

Graphium ulmi entered the tree through its leaves – and yet *Graphium ulmi* was not a typical leaf fungus, Schwarz went on.[27] Perhaps acarids damaged the wood and leaves, creating openings through which the fungus could penetrate the tree. Or perhaps the fungus invaded the tree after it had lost its leaves in the autumn. Young leaf veins also proved to be very easy to infect artificially. So infection was in principle possible throughout the year. Once it had entered a trunk the fungus destroyed the vascular walls. This disrupted water uptake, causing the young leaves to wither away. In other words, the perniciousness of the syndrome was that nothing at all could be seen on the outside of the tree, on the bark, when the internal vessels had been damaged.

The exact mechanism underlying the process of disruption was unclear, wrote Schwarz. According to one old hypothesis, wilt diseases, the category to which elm disease apparently belonged, resulted from an accumulation of fungus in the vessels, causing a blockage that would not admit water. But recent microscopic studies had shown that the amount of mycelium present in the vessels never attained the amount required to block the vessels entirely. A second theory was now gaining in popularity, according to which the tree itself responded to the fungus by producing certain substances that subsequently prevented the conduction of water. 'This may be classified, following Van der Lek, as a tracheomycosis, since it is a typical vascular disease', wrote Schwarz, citing the work of her fellow phytopathologist from Wageningen, adding 'although this does not essentially shed any more light on the matter.'[28]

Graphium ulmi was indisputably the cause; but the precise way in which it influenced the development of the disease was still unclear. Schwartz therefore advised against uprooting all infected trees at this stage.[29] It was also far too early to be able to say whether a pesticide was likely to be effective. Still, there was no need to be greatly alarmed about elm disease: only if conditions were conducive to its development for several years in a row was there any danger of a proportional increase in damage. The weather was the decisive factor.

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[26] Ibid., p. 27.
[27] Ibid., p. 21.
[28] Ibid., p. 68.
[29] Ibid., p. 30.

Dinner celebrating Bea Schwarz's doctorate, 1922. International Information Centre and Archives for the Women's Movement.

The existing scientific literature added little to her findings. Regarding Spierenburg's communication of 1921, Schwarz observed merely that its findings were highly tentative. Thus, she was familiar with Spierenburg's work, but did not derive any information from it. Finally, Schwarz concluded that although twig mortality also occurred in the weeping willow and peach tree, the process whereby this occurred in elm trees was of a fundamentally different order.[30]

As a symbolic gesture to mark the milestone achieved with this research, Schwarz and Westerdijk went out into the Doctors' Wood after the doctoral ceremony to plant a tree: not a weeping willow or a peach tree, but a small Dutch elm.

'Some gnashing of teeth on both sides'

'*Graphium ulmi* nov. spec.???'

J. Valckenier-Suringar, former professor of silviculture at the College of Agriculture, did not believe a word of it.[31] Since Schwartz had failed to include any

[30] Ibid., p. 69.
[31] J. Valckenier-Suringar, 'Eine Ulmenkrankheit in Holland', *Mitteilungen der Deutschen Dendrologischen Gesellschaft*, no. 32, 1922, pp. 145-147.

illustrative photographic material or positive results of infection experiments – that is, experiments producing the authentic leaf wilting as well as the brown discoloration – and since she had failed to distinguish between elm wood with 'normal' brown discoloration and that which displayed brown discoloration attributable to elm disease, she did not have a leg to stand on. She had been compelled to work in haste, and probably possessed too little material, concluded Valckenier-Suringar, and had therefore produced insufficient evidence for the identification of a new fungus as the causative agent; no, her supposed *nova species* [new species] was no more than a *nomen dubium* [questionable name].

Van der Lek, whose work Schwartz had briefly cited, also responded cuttingly to her dissertation. The term 'tracheomycosis', he wrote, was not his own, but that of his colleague Quanjer – since Ritzema Bos's retirement in 1920 director of the Institute of Phytopathology in Wageningen.[32] And as far as that remark about 'not shedding any more light' was concerned: back in 1918 he had emphasized the need to abandon the prevailing crudely mechanical line of reasoning by one based more on physiology. Only experimental research could provide greater insight into the essence of the disease process. Such research had demonstrated for a variety of wilt diseases that it was not the fungus itself that initiated the process of damage in vessels but toxins secreted by the fungus (or bacteria). In other words, his research was based on a major shift in research focus. And to Schwartz this was 'non-essential'!

Ritzema Bos – who, since his retirement, had devoted himself to reviewing the national and international literature of phytopathology for the *Tijdschrift over Plantenziekten* – devoted several pages to the state of research on elm disease in 1924, without a single mention of either Westerdijk or Schwarz. He did lift a quotation from the annual report for 1922 of the Netherlands Land Development Society (NHM, Nederlandsche Heidemaatschappij): 'it does appear that a fungus (which the most recent research identifies as *Graphium ulmi*) is the immediate cause of the mortality in elms, but all the evidence suggests that this can only produce such a devastating effect in trees already weakened by drought.' He added a note of his own: 'It is clear from the above that J.P. van Lonkhuijzen [a board member of the NHM] who, by virtue of his function, has had immense practical experience with the manifestation of elm disease, attributes the occurrence of this disease primarily not to the agency of a parasitical fungus, but to drought; it may be noted that Miss Dina Spierenburg also by no means regarded the fungi and bacteria that she cultured from the wood of diseased elm trees as the actual cause of elm disease, but took

[32] H.A.A. van der Lek, 'Afscheiding van giftstoffen door zwammen, welke ziekten der houtvaten veroorzaken', *Tijdschrift over Plantenziekten*, 1922, pp. 183-186.

the view from the beginning that the primary role in this disease was played by unfavourable external influences.'[33]

It is true that Spierenburg had stressed the role played by external conditions on the genesis and development of elm disease at the annual meeting of the NHM in 1922. 'Whether the fungus causes the disease cannot yet be stated with certainty.'[34]

'A practician is more inclined to ascribe the primary cause of plant diseases to weather conditions, while someone who works with the microscope ascribes greater influence to the fungi he encounters', wrote Westerdijk in a conciliatory tone in the daily newspaper the *Nieuwe Rotterdamsche Courant*. 'This will always lead to some gnashing of teeth on both sides. … In most cases it has become clear that both the right conditions and the parasite must be present for the disease to occur.'[35] Still, it remained incontrovertible, and of irrefutable accuracy, she insisted, that elm disease was an infectious disease attributable to a fungus.

After 1922, the incidence of elm disease appeared to be past its peak. The trees looked less diseased, and the number of reports of diseased trees was declining. Furthermore, inspections showed that many reports were in fact old cases, and related to trees that were already registered as diseased and now appeared to be in a worse condition or dying. This prompted Ritzema Bos to conclude that it was desirable 'for the planting of elms along lanes and roads, and in public gardens, which has been virtually halted in recent years, to be resumed as soon as possible.'[36]

In Baarn, life returned to normal. Undergraduates and PhD students flocked to Westerdijk, phytopathology and Villa Java like butterflies attracted by the light. In 1923, Christine Berkhout gained her doctorate on the strength of a monograph on several fungus genera that are hard to identify: *Monilia, Oidium, Oospora* and *Torula*.[37] The Central Bureau of Fungal Cultures contained 'many fungi from authentic material', she noted in her introduction. What she had done in her thesis, in all probability at Westerdijk's request, was to create order in the four fungus genera 'on the basis of extensive microscopic and culture studies.'

33 J. Ritzema Bos, '18. De iepenziekte', *Tijdschrift over Plantenziekten*, 1924, pp. 67-71, esp. pp. 68-69.
34 'Verslag van de 35ste Algemeene Vergadering', *Tijdschrift van de Nederlandsche Heidemaatschappij*, no. 10, 1923, pp. 332-335.
35 *Nieuwe Rotterdamsche Courant*, 20 July 1924, IIAV, archives of Westerdijk, no. 36.
36 J. Ritzema Bos, '18. De iepenziekte', *Tijdschrift over Plantenziekten*, 1924, pp. 67-71, esp. p. 70.
37 C.M. Berkhout, *De schimmelgeslachten Monilia, Oidium, Oospora en Torula*, PhD thesis Utrecht, 1923.

Pierette Bolle was next, in 1924, with an exposition of diseases caused by black fungi.[38] Modern phytopathology, she wrote, classifies diseases in groups bearing the names of the most conspicuous symptoms, rather than on the basis of fungi, as in the past. For the same fungus can give rise to different syndromes in different plants. Only if a syndrome is highly specific to a particular fungus do the old and new classification systems coincide. On the basis of the 'modern' disease classification system introduced by Westerdijk and Appel in 1919, she had investigated whether different black fungi, as the causative agents of diverse groups of diseases, did or did not belong to the same species.

Formally speaking, the Central Bureau of Fungal Cultures and the Willie Commelin Scholten Phytopathology Laboratory were two separate institutions with separate objectives, supervisory bodies and financial accountability regimes. In practice, however, the distinction was far more diffuse. Although the fungus collection occupied separate rooms, students and assistants were constantly going back and forth with fungus test tubes and culture media; and whether these were destined for research in the Phytopathology Laboratory, for use in a lecture, or for the conservation of the collection itself was often hard to see from the outside. What is more, several female students – Pierette Bolle, Bea Schwarz, and Maria Löhnis, for instance – worked as assistants at the Central Bureau of Fungal Cultures while researching their PhD theses. This combination obviously tended to go with a preference for mycological research.

In 1925, the first male PhD student, Karel Simon Thomas, received his doctorate.[39] His thesis too was composed of a mycological and a phytopathological part: the former dealt with the correct identification of *Rhizoctonia* strains, and the latter addressed the question of the extent to which the different strains were linked to specific culture media or families. Some of the phyla concerned originated from the Central Bureau of Fungal Cultures, while others had been isolated in the course of his own research. That same year, Catharina Doyer completed her thesis, in which she set about unravelling the different *Pestalozzia* strains (the mycology section of her work) and their parasitical effect on conifers (the pathology section).[40]

The triumphant year of 1927 saw the flag hoisted at the Villa a total of six times. In February, Jan Willem Roodenburg defended his PhD thesis on the relationship between the lack of oxygen in the soil and root rot.[41] With his

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[38] P.C. Bolle, *Die durch Schwärzpilze (Phaeodictyae) erzeugten Pflanzenkrankheiten*, PhD thesis Utrecht, 1924.

[39] K.S. Thomas, *Onderzoekingen over Rhizoctonia*, PhD thesis Utrecht, 1925.

[40] C.M. Doyer, *Untersuchungen über die sogenannte Pestalozzia-Krankheiten und die Gattung Pestalozzia* de Not., PhD thesis Amsterdam, 1925.

[41] J.W.M. Roodenburg, *Zuurstofgebrek in de grond in verband met wortelrot*, PhD thesis Utrecht, 1927.

direct reference to Hugo de Vries's 1878 inaugural address on the subject of 'respiration in plants', his focus on the difference in the root structure between plants growing on land and in water, and on the influence of changes in the concentrations of carbon dioxide, hydrogen, hydrogen sulphide, ammonia and oxygen on respiration, Roodenburg was the first graduate to produce a PhD thesis that was clearly based largely on physiological rather than mycological principles. Christine Buisman – the first PhD student to come from the University of Amsterdam rather than Utrecht University – followed in March, with a study structured in the familiar diptych model: a taxonomical exposition on different *Phycomycetes* and an experimental part on their influence on root rot.[42] Like Doyer, Buisman continued her work as an assistant in the Villa for some time after gaining her doctorate.

A week after Buisman, Jan Carel 's Jacob took his place at the lectern to defend his study of diseases caused by inadequate or inappropriate fertilization.[43] He had drawn his inspiration, he wrote, from the work of the German phytopathologist Sorauer, a scholar who had compelled the admiration of Ritzema Bos many years earlier, but who was now *passé* because of his many speculative assumptions. Relatively new soil diseases such as 'grey speck of oats' and 'Hooghalen disease' – both of which had recently attacked numerous agricultural crops in newly cultivated areas – proved not to be caused by fungi, bacteria or insects, but originated from inorganic conditions. Excess potassium, phosphorus, calcium, nitrogen, manganese sulphate, copper sulphate and boric acid – the primary constituents of numerous modern fertilizers – caused the pathological symptoms that had been reported; moreover, just as an excess of specific nutrients could cause plants to wither away, so too could a lack of the proper nutrients.

In May, J.P. Karthaus gained his PhD with a thesis on the causes of mortality in the buds and stems of the red raspberry, a problem that was evidently spreading in Breda and the surrounding area.[44] He identified a number of different fungi as the causative agents, beside which he suspected the concomitant presence of viral diseases. A.C.B. Pfälzer opened his thesis, in July 1927, with a bold statement: a phytopathologist should not be content to produce only pure scientific research – in this case, the description of a particular syndrome and the morphology of the fungus causing it – the ultimate and primary objective was the application of the knowledge acquired; in other words, *controlling* the

[42] C.J. Buisman, *Root rots caused by Phycomycetes*, PhD thesis Amsterdam, 1927.
[43] J.C. 's Jacob, *Anorganische beschadigingen bij Pisum sativum L. en Phaseolus vulgaris L.*, PhD thesis Utrecht, 1927.
[44] J.P. Karthaus, *Het afsterven van stengels en knoppen bij de roode framboos*, PhD thesis Utrecht, 1927.

disease.[45] A variety of solutions had proved ineffective in controlling scab and gummosis as well as *Corynespora* blight and target spot in cucumber: cleaning the greenhouses, using pure seed, removing and incinerating diseased plants as quickly as possible, ventilating greenhouses, the use of Bordeaux mixture, liver of sulphur or flowers of sulphur, and the avoidance of high temperatures. He had therefore produced an analysis of the way in which the fungus succeeded in penetrating the cucumber, on the basis of which he analyzed a variety of new methods of control. The best results would probably be gained by disinfecting the soil, he concluded.

On the same day, A.G.M. Liernur received his doctorate on the strength of a thesis on the genesis, morphology and anatomy of witches' broom disease; many types of this disease were still unknown, he wrote, and there was no comprehensive literature on the subject.[46] He then proceeded to give a detailed survey of the literature, as well as descriptions and drawings of witches' broom disease in magnolia and in elm, chestnut, birch, pine and beech trees.

Shorter monographs by Westerdijk, her students, and members of her permanent staff – including staff at the Central Bureau of Fungal Cultures – were published between 1920 and 1928 in the Laboratory's *Communications* (*Mededeelingen uit het Phytopathologisch Laboratorium Willie Commelin Scholten*), nine new issues of which appeared in this period. In the issue of May 1920, for instance, her permanent assistant A. van Luyk, together with Westerdijk, published four purely mycological treatises,[47] followed by two more in that of April 1924,[48] and another two in that of November 1924.[49] The difference between these and the publications of Dr F.H. van Beyma thoe Kingma, the permanent research assistant of the Central Bureau of Fungal Cultures from 1926 onwards, who published his first mycological article in the issue of February 1927, is minimal[50]; in all of these cases, the authors discussed the correct identification of a known or newly discovered pathogenic fungus,

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45 A. Pfälzer, *Het vrucht- en bladvuur van de komkommer, Cladosporium cucumerinum* Ell. en Arth. *en Corynespora melonis* (Cooke) L., PhD thesis Utrecht, 1927.

46 A.G.M. Liernur, *Hexenbesems, ihre Morphologie, Anatomie und Entstehung*, PhD thesis Utrecht, 1927.

47 *MPLWCS*, vol. 4, May 1920: J. Westerdijk and A. van Luyk, 'Die Gloeosporien der Eiche und der Platane'; A. van Luijk, '*Gloeosporium ribis*'; J. Westerdijk and A. van Luyk, 'Die Kultur der *Phoma Arten*'; J. Westerdijk and A. van Luyk, '*Phytophthora erythroseptica* Peth. als parasit von *Atropa belladonna*'.

48 *MPLWCS*, vol. 6, April 1924: J. Westerdijk and A. van Luyk, 'Untersuchungen über *Nectria coccinea* (Pers.) Fr. und *Nectria galligena* Bres.'; J. Westerdijk and A. van Luyk, 'Die Gloeosporien der Eiche und der Platane II'.

49 *MPLWCS*, vol. 8, November 1924: J. Westerdijk and A. van Luyk, 'Über einige Gefässkrankheiten'; J. Westerdijk and A. van Luyk, 'Eine Anthraknose des Kümmels'.

50 *MPLWCS*, vol. 10, February 1927: F.H. van Beyma thoe Kingma, 'Über eine Botrytis-art von Rotkleesamen'.

Youngest servant, Jan Kiljan, in the kitchen. Archives of the WCS, Haarlem.

and placed this identification in the context of a debate on the different distinguishing features that were popular at the time (whether based on material from a herbarium, pure cultures, or infection experiments).

Aside from mycological communications, the Laboratory also published shorter, technical reports, on methods for preserving fungi, or on biometrics as an indispensable, complex new instrument in the taxonomy of fungi. A number of PhD theses were also published as *Communications*.[51]

Since these *Communications* were not only published to disseminate information but also served as a means of exchange for foreign periodicals – a crucial factor in the years of international recovery after the First World War – the knowledge network surrounding Baarn naturally became both wider and denser as time went by, like the spreading crown of a healthy tree.

As the trees in the Doctors' Wood increasingly concealed the Villa from the outside world, books and periodicals piled up in the library, PhD students travelled back and forth, and groups of student lab workers regularly swarmed around the Villa, Westerdijk fanatically read every word that was published on

[51] Viz. M.B. Schwarz (*MPLWCS*, vol. 5, December 1922); P.C. Bolle (*MPLWCS*, vol. 7, April 1924); C.M. Doyer (*MPLWCS*, vol. 9, June 1925); C. Buisman (*MPLWCS*, vol. 11, May 1927).

elm disease. With growing disgust she noted that the efforts to gain insight into the disease were still 'plagued by ignorant tittle-tattle.'

The situation became a professional embarrassment in 1925, when the German bacteriologist A. Brusoff claimed to have discovered that elm disease was not caused by a fungus or weather conditions or a combination of the two, but by a bacterium. When he saw fit to sound the alarm a year later, asserting in the much-read journal the *Umschau* that the old, sick soil of Europe was now totally saturated with this bacterium, which he called *Micrococcus ulmi* nov. sp., so that not only Europe's elms, but also its lime trees, maple species, poplar, beeches and hawthorns were doomed beyond remedy – panic erupted.

'If this bacterium does indeed cause the disease and is present in such quantities in all the soil', wrote G. Houtzagers, horror-stricken, in the journal of the NHM (*Tijdschrift der Nederlandsche Heidemaatschappij*) 'the situation is very grave indeed. A medicine must be invented that kills the bacterium in the soil, or which can neutralize its action, or that of a particular substance that can be isolated, following its absorption by the trees – in other words, a kind of "internal treatment".'[52]

Perhaps the time has really come to start thinking about a different tree, suggested the executive committee of the Royal Dutch Society of Horticulture and Botany – and wrote a letter to this effect to the Ministry of Agriculture, which promptly set up a fully-fledged research committee mandated to decide which tree would serve best as a replacement for the elm.[53] The first letter received by the new committee, on the very day of its appointment, was from the executive committee of the Society for the Promotion of Beekeeping, which seized the opportunity to advance its cause by urging the need to plant trees that would yield nectar.

Perhaps this is truly a question of 'nature' rejecting the 'unnatural', suggested a staff member of the NHM, voicing the silent suspicions of many growers, traders and experts in the field. Trees with a healthy constitution and a strong root system, growing in the soil that is best suited to them, do not succumb to disease so easily. The ceaseless grafting, budding, taking cuttings, and layering of tree species, also known as 'asexual, monogenic or vegetative propagation'; all this produced weakened, degenerated, sickly trees. After all, were there not fine healthy trees standing among the dead and half-dead ones? It was the outcome of a perfectly natural struggle for life, followed by the

[52] G. Houtzagers, 'De iepenziekte en haar voorkomen op andere houtsoorten', *Tijdschrift der Nederlandsche Heidemaatschappij*, no. 6, 1927, pp. 177-180.
[53] *Verslag van de commissie inzake de vervanging van den iep*, 1928, p. 3. This Committee had been established on 9 April 1927.

inevitable survival of the fittest.[54] It was not a fungus or bacterium that was causing disease in the trees; it was nature itself, which was intervening as if guided by a higher power, allowing only the strongest trees to survive. Perhaps elms simply did not belong in the Netherlands.

It made Westerdijk's blood boil. 'No!' she fulminated, 'the stronger the parasitical properties possessed by a particular fungus, the better its capacity to invade healthy, sturdy trees. The deaths of so many elms that were initially perfectly healthy and thriving prove that they must have been attacked by a vicious parasite. We see exactly the same among humans. It is often really vigorous bodies that are destroyed by infectious diseases. … Elms have felt at home and thrived in our climate for centuries. They have certainly passed through numerous bad spells down the centuries. But these have not destroyed the tree, which has been described as so perfectly 'at home' here, as a tree that 'will thrive anywhere'.'[55]

'No', she went on: 'it is at present engaged in a strenuous battle with a parasite. I cannot possibly be optimistic as to the outcome. The Dutch passionately want their elms to be victorious again, and they therefore prefer to think that everything will work out all right in the end, and that elm disease is a periodic affliction. … But there is absolutely no basis for this assumption in the case of a virulent parasitic disease, especially given that no obvious pesticide exists for its control.'

In the summer of 1926, the executive committee of the NHM had proposed to the Phytopathology Laboratory that it use a grant of 2,000 guilders provided for two consecutive years by the Prize Competition Institute of the society 'Oranjebond van Orde' to conduct further research into the causes of elm disease and ways of controlling it.[56] Westerdijk immediately delegated the research to Christine Buisman, who had recently gained a PhD under her supervision. This resulted, in 1928 and 1929, in a number of individual articles and the influential compilation *De Iepenziekte* ('Elm Disease'), all formulated in the same forceful tone and all with the same adamant conclusion: *Graphium ulmi* was the cause of the disease, and the only remedy was to find a resistant type of elm.

Brusoff's *Micrococcus ulmi* did not exist, Westerdijk wrote dismissively in her own contribution to *De Iepenziekte*; his experiments were highly suspect and

[54] C.A.L. Smits van Burgst, 'Over immuniteit bij planten en de boomensterfte', *Tijdschrift der Nederlandsche Heidemaatschappij*, no. 5, 1925, pp. 139-145, esp. pp. 144-145.
[55] J. Westerdijk, 'Is de iepenziekte een infectie-ziekte', *Tijdschrift der Nederlandsche Heidemaatschappij*, no. 10, 1928, pp. 333-337, esp. p. 336.
[56] See F.B. Löhnis, 'Prijsvrageninstituut van den Oranjebond van Orde', *Tijdschrift der Nederlandsche Heidemaatschappij*, no. 5, 1927, pp. 129-135.

had scarcely been taken seriously in the international phytopathology community. Valckenier Suringar was simply ignorant about fungi, and provided 'platitudinous criticism of such inferior quality that it was truly hard to understand why the Dendrology Society had printed it.'[57] Serious researchers, such as the staff of the Biologische Reichsanstalt in Berlin-Dahlem and in Bonn, had repeated Schwarz's original experiments and confirmed the results.

'Finding a different "Dutch elm" is the only action that can be taken against elm disease', Westerdijk repeated in *De Iepenziekte*. 'It would be irresponsible not to try to do so. It is an ostrich-like policy to "believe" that this disease will disappear naturally. We are fortunate that our physicians have never cultivated such a belief with regard to our own diseases. Let us not do so for our elms either.'[58]

One major difference in relation to Schwarz's research in 1922 was that Buisman had now succeeded, where Schwarz had failed, in inducing the external symptom of elm disease, namely the wilting leaves in the crown of the tree, in infection experiments. The crucial factor, it turned out, was the time of injection: only if the tree was injected with *Graphium* between June and mid-August would the leaves wilt. If injected at some other time, the wood did exhibit the characteristic brown discoloration, but the leaves did not flinch.

This put paid to Schwarz's view that infection was possible at any time of the year, as well as her assumption that infection occurred after the trees had lost their leaves in the autumn. Where and how, then, *did* the trees become infected?

There were three possible sites of penetration for the fungus, wrote Buisman: places of natural damage (scar tissue on flowers or leaves); places of artificial damage (pruning cuts, insect bites or stings, mechanical damage), and natural orifices (stomas and lenticels). The first of these three could be discounted, she went on, since the time of infection and the occurrence of natural damage did not coincide. The second too could largely be discounted, since pruning had frequently proven to be a successful remedy against the disease. Buisman had never been able to establish a link between insect damage and a *Graphium* infection; on the other hand, she noted: 'the fact that artificial spraying [with a suspension of spores of *Graphium*] has thus far yielded negative results does not prove that infection does not take place in this way in natural conditions.' Schwarz had seen that *Graphium* spores infiltrated leaves in petri dishes, but it was 'improbable', continued Buisman, 'that a vascular fungus infiltrates through stomas.'[59] In other words, the third possibility too could be ruled out.

[57] J. Westerdijk and C. Buisman, *De Iepenziekte, rapport over het onderzoek verricht op verzoek van de Nederlandsche Heidemaatschappij*, Arnhem, 1929, pp. 5-6.

[58] Ibid., p. 12.

[59] Ibid., p. 34.

'Reviewing all the points that have been dealt with', she concluded, 'One can only conjecture as to the place of infection in natural conditions. … In my opinion, small apertures are the likeliest sites of penetration for the spores. The largest part is probably played by tiny openings caused by mechanical damage and insect bites or stings.'[60]

The *Graphium* spores were most probably disseminated by the wind or by insects, wrote Buisman. An earlier suggestion, that birds, dust or packaging material might be responsible, seemed to her improbable. Since trees located at windy street corners had proven more susceptible to disease than others nearby, she concluded, the wind was probably the primary factor in disseminating the disease.[61]

No, not the wind, wrote J.G. Betrem, a member of staff at the Entomology Laboratory of Wageningen College of Agriculture, two months later; the culprit was the large elm bark beetle, *Scolytus scolytus* F. 'I had already suspected that the elm disease was transmitted by the elm bark beetle back in 1927', he stated. 'Since Miss Buisman was already studying this disease, I did not subject the matter to any further scrutiny. Now that the report of her work has been published, I have resumed the research I began at that time, and with good results, as I hope will become clear in the following pages.'[62]

In retrospect, everyone was surprised that the connection had not been made earlier on. One explanation for this, wrote Betrem, might be that the life cycle of the elm bark beetle had been the subject of relatively little research, and that its description was therefore incomplete. But the combination of the existing knowledge of the beetles with what Buisman had now confirmed of Schwarz's research provided a picture of an infection cycle that was surprisingly logically cohesive.

Sexually mature large elm bark beetles, infiltrating through a split in the bark, bored tunnels or galleries of some 30 to 50 millimetres into the bark. It took them about three weeks to do so. 'Once they have finished their gallery, they copulate. … The males crawl restlessly back and forth over the tree until they find a gallery. They enter it and pull the female out. Copulation takes place while the female is still in the tunnel.'[63]

The female then lays her eggs on either side of the mother tunnel. When the larvae emerge, they feed on the bark. They then bore through the bark, creating tunnels at right-angles to the mother tunnel and increasingly wide, up

60 Ibid., p. 34.
61 Ibid., p. 35.
62 J.G. Betrem, 'De iepenziekte en de iepenspintkevers', *Tijdschrift over Plantenziekten*, 1929, pp. 273-288.
63 Ibid., p. 276.

to a total length of about 10 cm. In late May or early June, the first generation of beetles emerges from the bark. They are not yet sexually mature at this stage, and fly to the highest branches of the elms. There they feed on the bark for some time and on the wood beneath it, known as *Reifungsfrass*. They feed on diseased trees if necessary, but prefer healthy ones. When they are ready to bore tunnels, however, they favour diseased or sickly trees – 'because in completely healthy parts of trees, the bark secretes so much moisture that the tunnels gradually fill up with a watery fluid.'[64] This would cause the beetles to drown.

This much was known. What Betrem and his team did next was to remove large elm bark beetles from galleries in diseased elms and induce them to crawl over sterile agar plates. He found that large numbers of colonies of *Graphium ulmi* developed on the plates. He then shook the beetles with sterile water and added this water to cherry agar. This time, several colonies of the fungus grew on the agar. He then disinfected some beetles and dissected their intestines. He found that a colony of *Graphium ulmi* developed from the intestines. 'This shows conclusively that the large elm bark beetle can transmit elm disease', he concluded.[65]

The hypothesis was that the beetle became infected with the fungus at the pupal stage and transmitted the infection when it bored into a new tree. Buisman had shown that the months from June to August were the best time in which to infect the elms. 'And it is precisely in this period that the large elm bark beetles hatch and are dispersed…. The above account makes it abundantly clear that any attempt to control elm disease must involve controlling the large elm bark beetle.'[66]

Even before Betrem's findings were published, the Plant Protection Service sounded the alarm.[67] Elm disease proved to be the consequence of a cooperative venture involving fungus and beetle – controlling it would also have to be a collaborative effort. In theory, there were three ways of attacking the disease: destroy the fungus, destroy the beetle, or find a resistant tree. The first of these options could be discarded, since any agent that killed the fungus would also damage the tree. Staff at the Entomology Laboratory in Wageningen rapidly set about investigating the second option, while the Phytopathology Laboratory in Baarn looked at the third. Until one of these options was operational, there was no alternative but to chop down every diseased tree as quickly

[64] Ibid., p. 275.
[65] Ibid., p. 279.
[66] Ibid., p. 279.
[67] 'Berichten van de Plantenziektenkundige Dienst', *Weekblad der Maatschappij voor Tuinbouw en Plantkunde*, 9 November 1929; PD, Bericht no. 245, 3 October 1929.

as possibly and incinerate it, to prevent any further spread of the disease. And this operation provided work for the Plant Protection Service, since early diagnosis required regular, expert inspections of trees nationwide. Thus, the diseased elms had the effect of bringing together the country's different phytopathology institutions in a joint strategy.

In 1930 – a year in which elm disease 'recurred in a very severe degree in a large part of the country' according to the Plant Protection Service'[68] – a concerted effort was planned in a new Committee for the Study and Control of Elm Disease, a collaborative structure that brought together, aside from the bodies already mentioned, the National Forest Service, the Association of Expert Superintendents of Municipal Parks and Gardens in the Netherlands, the NHM, and the acting director of the State Forestry Experimental Station. In this committee, all those concerned put their heads together: facts and opinions, strategies and propaganda were exchanged and thrashed out; the committee took the initiative for national fund-raising drives to finance research and to keep the disease under control. Well into the 1990s, to a large extent through the work of this committee, elm disease was kept at bay, so that there was no question of the elm being banished forever from the Dutch landscape.

'People are sentimental about every tree that perishes', Westerdijk had said back in 1928. 'They should not be so for a diseased elm: the sooner it goes the better.'[69]

Professor in Amsterdam

It would be a far healthier attitude, declared Westerdijk in 1930, if the Dutch, who took such pride in their level-headedness, could convert their 'almost morbid love of every vanishing elm tree into a lively interest in research on its afflictions.' While plant doctors toiled away, they [i.e. the Dutch] possessed an 'extraordinarily strong inclination to blare out every little idea that came into their heads, thus failing to recognize phytopathology as a science.'[70]

There she stood again, in her gown and cap, once again addressing an erudite audience. She was now 47 years of age, and had once again been appointed

[68] Report on the activities of the PD in the year 1930, 'De iepenziekte en haar bestrijding in 1930', 1930.
[69] J. Westerdijk, 'Is de iepenziekte een infectieziekte?' *Tijdschrift der Nederlandsche Heidemaatschappij*, no. 10, 1928, p. 337.
[70] J. Westerdijk, *De groei der phytopathologie*, inaugural address given upon accepting the position of extraordinary professor at the UVA on Monday, 5 May 1930.

Ladies' dinner organized to mark Westerdijk's inaugural address in Amsterdam, 1930. International Information Centre and Archives for the Women's Movement.

extraordinary professor of phytopathology – this time at the Municipal University of Amsterdam. And once again it was students who had requested her appointment; this time their request had been heeded.

Perhaps the success was attributable to the fact that her appointment was now a completely separate affair, without any interference from invisible forces, complex political relations, or circuitous arguments along the lines of 'if this, then that'. In this case, all that happened was that J. Kruseman, who was then secretary of the board of governors, received a letter from the student G. Kruseman, signed by 65 other students, requesting that 'Amsterdam too provide Professor Westerdijk with the opportunity to lecture and assume leadership in phytopathology.'[71]

Another letter, from the faculty of mathematics and physics, stated that 'the students have rightly drawn to your attention that more and more are choosing phytopathology as a subsidiary subject and as a subject for a

[71] GAA 279, inv. 98, notulenboeken CC 1920-1935, minutes of meeting held on 3 December 1928.

PhD thesis, primarily with a view to securing some colonial office.'[72] And that it was equally true that while the students were welcome in Baarn as guests, they did not have any opportunity to attend lectures in phytopathology or to prepare a PhD thesis on a related subject in Amsterdam. Major interests were at stake, offset by only a small financial sacrifice, and it was therefore advisable to appoint Westerdijk.

'The tradition – albeit an interrupted one – shall be continued', state the minutes of the 1929 faculty meeting, with evident satisfaction.[73] At length, Amsterdam's municipal executive appointed Westerdijk as extraordinary professor of phytopathology, for an annual salary of 4,000 guilders, in December 1929. She was to take up her duties on 1 May 1930. Five days later, she addressed an auditorium bursting at the seams on 'the growth of phytopathology.'

The card from Hugo de Vries – 'Allow me to congratulate you on your appointment in Amsterdam, where I myself had the task of teaching phytopathology many years ago' – was thrown into a box, unanswered.[74] The two were no longer on speaking terms.

'[De Vries] is not on good terms with Hans, and it is his fault that she was not appointed extraordinary professor in Amsterdam', Went had written to Krelage in 1928.[75] And a few months after her inauguration, Westerdijk wrote to Went: 'If there is the slightest chance of De Vries turning up, I would personally feel *wretched* about it', when discussing the invitations for the celebrations of her 25th anniversary as director of the WCS.[76] 'I have such an aversion to the sight of De Vries that it would ruin my entire day. That may be pathological, but it is true all the same.'

It seems a fair assumption that the failure of her appointment in 1920 – which she basically orchestrated herself – was only identified retrospectively as the source of the alleged animosity between De Vries and his most successful female student. Whether there was any specific reason for her aversion, we can no longer ascertain. Even so, in her second inaugural address, she expressed her gratitude, in public, for the teaching of her old mentor Hugo de Vries.[77]

72 FWN to CC, 7 February 1929, GAA 1020, inv. 208, correspondence 1928-1929.

73 Minutes of the FWN of 14 – n.d.- 1929, GAA 1020, inv. 6, notulenboek 1922-1930.

74 Hugo de Vries to Westerdijk, 3 February 1930, IIAV, archives of Westerdijk, no. 81.

75 Went to Krelage, 20 September 1928, IIAV, archives of Westerdijk, no. 6.

76 Westerdijk to Went, 12 September 1930, archives of Westerdijk, MB, Leiden.

77 J. Westerdijk, *De groei der phytopathologie*, inaugural address given upon accepting the position of extraordinary professor at the UVA on Monday, 5 May 1930, p. 29.

5 Sturm und Drang

On Saturday 14 March 1931, Westerdijk celebrated the twenty-fifth anniversary of her directorship. Early in the morning, she and her mother were driven to the Badhotel in Baarn, where the entire board of the Willie Commelin Scholten Phytopathology Laboratory Foundation awaited her for the fiftieth board meeting.

Before Went opened the meeting, however, Westerdijk made him a gift of a gavel, 'to remedy the absence of a gavel in the years behind us', the venerable Ernst Krelage, secretary of the board, recorded gravely in the minutes.[1] In this close circle of board members, Went then proceeded to share with his fellows some reflections which were 'better not aired in public.'[2] He doubtless closed the meeting with a merry tap of his new gavel.

After lunch followed the official ceremony. Seated grandly among several lush flower arrangements and surrounded by hundreds of people who had arrived to pay tribute to her, including professors, local dignitaries, students and former students, friends and acquaintances, Westerdijk listened to Went's speech, which was interrupted half-way through by two crackling radio tributes from the Dutch East Indies. After dinner, students performed a revue in the auditorium of Baarn's Lyceum, the local grammar school. One of the highlights of the festivities was the reappearance of the traditional puppet show: former students put Punch and Judy through their paces one more time, with some idiosyncratic commentary on the guest of honour. The dancing and merrymaking went on until the early hours.

The anniversary did indeed mark the end of an era. For one thing, only Krelage, Went and Hugo de Vries, of the original founders, were still alive; the latter two were nearing the end of their careers, and both would die in the summer of 1935. After that, only Krelage, who, since the collapse of the bulb market after the First World War, had been forced to sell the firm of E.H. Krelage

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1 NWCS, Archives of the WCS.

2 Went to Krelage, 10 February 1931, Archives of the WCS.

Westerdijk and Went listening to radio broadcasts from the Dutch East Indies, Baarn 1931. International Information Centre and Archives for the Women's Movement.

& Son, and whose board membership was therefore based purely on historical considerations, could bear witness to the old times. But it was the end of an era in another sense too: with Westerdijk's dual appointment as professor of phytopathology, the Phytopathology Laboratory had finally achieved its destiny as a public, university laboratory, rather than a private foundation. This transformation was accompanied by several drastic changes.

First, the board had to adjust to its new role: while in the past it had decided autonomously on all matters relating to the laboratory, it now had to share this power with the authorities of the universities of Utrecht and Amsterdam, which had more money and hence more influence; they soon made this felt by making more demands.

What these university authorities required of the board of the Willie Commelin Scholten Phytopathology Laboratory, and more specifically of its director, Westerdijk, was on the face of it perfectly simple: to teach their students phytopathology. 'In this connection', wrote Westerdijk to the University of Amsterdam on 18 April 1929, before her professorial appointment, 'I would bring the following matter to your attention. My duties have already expanded considerably, as extraordinary professor in Utrecht, as director of the Willie Commelin Scholten Foundation, and as director of the Central Bureau of Fungal Cultures (CBS). Moreover, up to now they have taken up all my time,

An evening of student drama. International Information Centre and Archives for the Women's Movement.

since the assistance made available to me in these positions may be described as wholly inadequate. Thus, the second professorship can only be realized if various forms of assistance are provided.' She then proceeded to elucidate her requirements in detail: an annual salary equal to that provided by Utrecht University (4,000 guilders), a full-time administrative assistant, funds to build and equip a place for students to do lab work, assistance for students doing lab work in the summer months, exemption from teaching in the month of October, a collection of wall charts and other teaching aids, and a gardener or factotum.[3]

These demands were not ridiculous – a second professorship obviously called for all sorts of adjustments and expansions. But they were scarcely *proportional*. The Amsterdam professorship was not as dramatic as all that. The point was rather, as Westerdijk wrote herself, that the assistance had until then been 'wholly inadequate.' It appears that both she and the board were using the prospect of a double appointment as an opportunity to start with a clean slate after a past strewn with unforeseen changes and a course that had oscillated between pure service provision on the one hand and independent research on the other. If the Laboratory's future, its significance, and indeed its essence was to be defined by a university context – and recent developments certainly pointed in that direction – what could be more natural than to adapt it to the requirements of undergraduates and graduates alike, including the proper facilities for lab work? In the event, most of her demands were met in some way.

The board embraced its new role with gusto. Its new gavel sounded smartly to approve Westerdijk's university plans and ambitions wherever the board had the authority to do so – which was largely in the area of funding. One of its decisions, for instance, was to use the substantial bequests that the CBS and the Phytopathology Laboratory had received at the end of the 1920s to renovate the Villa to allow more students to work and study there, in more comfortable surroundings.[4] Central heating was to be installed. The coach-house would be converted into a space for thirty students to do lab work. The board also set

3 Reply to the FWN, Amsterdam, 'naar aanleiding van een aanvrage om een buitengewonen leerstoel in de Phytopathologie te bezetten', 18 April 1929, file labeled 'Privé-correspondentie met Trans Utrecht en Amsterdam Faculteit', Archives of the WCS.

4 In 1928, the CBS received 16,000 guilders from Odo van Vloten, while in 1929 the WCS received 15,000 guilders from an unknown beneficiary (probably Maria Löhnis). Two years later this same Van Vloten bequeathed almost two million guilders to the CBS. Westerdijk was indignant that CBS had been so regally endowed, leaving very little for Van Vloten's widow. NWCS, 24 March 1931, Archives of the WCS.

5 In 1934 the CBS acquired legal personality (as the Central Bureau of Fungal Cultures Foundation), under the aegis of the KNAW. It was allocated a number of dedicated rooms within the Villa.

about giving the CBS greater financial autonomy and a more secluded space.[5] In addition, it devoted strenuous efforts to the management of the Foundation's private capital – an imperative, given the collapse of the global economy.

Westerdijk's role and workload also changed. Once she had been appointed at two universities, the WCS Foundation was no longer her main employer. As her teaching responsibilities expanded,[6] so too, inevitably, did her paperwork.

Several files in the archives bring this pre-war bureaucracy to life in all its enormity. Page after page testifies to the many hours that Westerdijk must have sat upstairs at her desk in the Villa, reading, digesting and responding to a plethora of forms, rules and regulations; even though after her double appointment, the entire staff of the Phytopathology Laboratory still consisted of only six people, including herself.[7]

Printed circulars from Utrecht University with 'Regulations on the use of fuel' and procedural rules for the correct despatch of surplus goods issued by the Government Procurement Office. 'I do not have any surplus goods', Westerdijk scribbled in the margin. Regulations for uniforms: 'a laboratory coat for the assistant Kiljan', noted Westerdijk, but this had already been purchased from the budget of the WCS Foundation.

With unrelenting regularity, the postman delivered lists of advance payments and receipts, cards for insurance stamps, instructions about leave regulations and leave cards for civil servants, and requests for itemized lists of postal items despatched, such to be supplied per quarter and classified under the headings of local official letters, other official letters, local official postcards and other official postcards.

Battles were sometimes fought over a few cents. The cleaner's wages, for instance: 31 cents an hour, decreed Utrecht's board of governors, and not half a cent more. 'Baarn is a high-grade facility, where domestic staff earn more than in Amsterdam', Westerdijk wrote back. 'So now I am forced to supplement these wages from the Foundation's budget; otherwise I would have to

[6] Initially, the new situation boosted her financial situation. At her appointment in 1906, she earned 2,500 guilders a year (Ritzema Bos's salary had been 4,500 guilders). In 1930 her formal salary at Utrecht University was set at 4,000 guilders a year, and she was awarded the same salary at the University of Amsterdam. In practice, however, she received far less, on account of a variety of deductions. In 1936, her income reached an all-time low, when she received only 3,078 guilders from Utrecht University and 3,320 from the University of Amsterdam.

[7] Two assistants (A. van Luyk and Miss A. Jaarsveld), one deputy assistant (Miss C.W. van Bilderbeek), one caretaker/servant (J. Kiljan), a gardener/odd-jobs-man (C. van Veenendaal) and a cleaner. For purposes of comparison: in 1914 (when only Westerdijk and Van Luyk were working at the WCS in Amsterdam) the Institute of Phytopathology in Wageningen already had a staff of twelve.

[8] Westerdijk to the secretary of the CC, UU, 17 November 1927, cover of *Correspondentie Trans 10*, Archives of the WCS.

hire some character from the slums.'[8]

The director's typewriter would occasionally be heard rattling away until late in the evening: paper generated more paper. In practice, the grand professorship often came down to playing post office. But in exchange for this work, the laboratory acquired the facilities that would enable it to grow into a centre of scientific phytopathology, with a pivotal position in the relations between the Netherlands and its colonies when it came to delivering highly-trained phytopathologists.

The growth of phytopathology

'Thirteen years ago', Westerdijk remarked in her inaugural address in Amsterdam, 'I said that our discipline was still in its infancy, and that we scarcely knew how it would develop. In that period of time, a child can mature into a youth. To the outside world, he is in blooming health and apparently enjoying the easiest time of his life – in reality, this age of *Sturm und Drang* is the most difficult of all.'[9]

'It appears as if phytopathology has gone through a period of vigorous growth', pronounced Westerdijk to the auditorium in Amsterdam. 'It has put out very strong shoots … and I would estimate that the number of practitioners in the field has doubled over these thirteen years.' But like the youth who was unsure of what direction to choose, who did not yet know where his strengths and weaknesses lie, and who might therefore have difficulty developing harmoniously into a well-balanced adult, phytopathology now found itself in that difficult stage of life: 'Many branches have failed to flourish, pathological stagnations are not uncommon, latent buds abound. By looking critically at the vigorous and halting new shoots, we can form a picture of what it could potentially grow into.'[10]

To begin with, there was research on 'biotypes of vegetable parasites'. While this was a powerful branch of the main trunk, declared Westerdijk, it had undeniably produced a host of puny little shoots that had never in fact matured. She gave the example of research into the physiology of parasites, which greatly lagged behind descriptions of fungi. The weapons with which a parasite attacked its host were physiological in nature, she went on: 'but their nature and constitution are unknown; nor do we know in detail what parasites require, in terms of substrate, to proliferate.'[11] Much work remained to be done there.

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9 J. Westerdijk, *De groei der phytopathologie*, inaugural address given upon accepting the post of extraordinary professor at the UVA, Monday 5 May 1930, p. 5.

10 Ibid., p. 6.

11 Ibid., p. 7.

Then there was the study of viral diseases. Thirteen years earlier, said Westerdijk, the majority of phytopathologists had rejected the very concept of a 'virus' as a heresy – but with Quanjer's research the Netherlands had now taken the lead in this field, and was keeping pace with the United States. Strange things, those viruses, mused Westerdijk: 'People have been vying with each other to identify these tiny entities since 1916, we have seen dozens of images of them. But no one has yet seen any "life" in them. No movement … no reproduction.'[12] Yet they posed a threat to our crops, although they were being watched vigilantly in the Netherlands, this in contrast to Germany. 'It is my firm conviction that if phytopathological research receives support in all the continents of the world, and geneticists too keep a watchful eye on susceptibility to these diseases in hybridization experiments, they can be contained, although many may have to forego the sight of a favourite dahlia and many a potato-lover may have to do without floury chips.'

Lastly, said Westerdijk, there were topics relating to disease and nutrition, which, having slumbered for years, were finally showing signs of growth. 'I am referring here both to physiological nutritional disorders, in which improper nutrition causes a disease, and to parasitic diseases, which are exacerbated by improper nutrition.'[13] Too much calcium, too little potassium, too much phosphorus, too little iron, the influence of the acidity of the soil, nitrogen compounds, the influence on growth of temperature and of the lack of trace elements; all subjects that were of great importance to the harmonious growth of phytopathology. But up to now, observed Westerdijk, these areas had been studied primarily by chemists, soil scientists and plant physiologists; if solutions were to be found, plant pathologists too would have to devote more attention to them.

There were plenty of issues for phytopathologists to tackle, she told her audience, besides which good diagnosticians were in short supply: 'many plant doctors lack the expertise and experience to assign a disease to one of the groups mentioned.'[14] She went on to look at possible reasons for the shortage of good diagnosticians. A diseased plant was a simple object in comparison to a sick human being, said Westerdijk; one could cut it open, examine diseased parts using a microscope, conduct all manner of experiments with it, without the need for caution, either physically or emotionally.' On the other hand, the diagnosis of plant diseases was far less compelling: 'I do not believe that any

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[12] Ibid., p. 14.

[13] Ibid., p. 17.

[14] Ibid., p. 26: Westerdijk had distinguished between two groups of diseases: parasitic and physiological. The first was dominated by pathologists and the second by chemists. Few people were expert in both fields, Westerdijk observed.

plant doctor suffers sleepless nights because of a bed of diseased peas, although unsolved questions of immunity in pea varieties may plague him in his dreams.' Still, in another sense, physicians who dealt with human diseases had an easy life: 'You physicians have only one patient species to deal with, we phytopathologists have hundreds. Today a lily-of-the-valley, tomorrow an elm tree, the next day Java coffee.'[15]

The solution lay in creating a larger number of training places, conducting more research, and more interdisciplinary studies. 'The entire spectrum of teaching in phytopathology, only some parts of which could be provided after the departure of Ritzema Bos, will now be resumed in full. … Amsterdam is now the only university in the Netherlands at which all the various groups of plants' enemies can be studied, animal and vegetable alike.'[16]

Disease as a process

At the end of the 1920s, the shift of emphasis Westerdijk had indicated did in fact become visible in the types of research done at the Phytopathology Laboratory. Until then, attention had focused primarily on the *disease* afflicting a plant or crop – 'Diagnostics and Control', as Westerdijk summarized it.[17] This type of research followed a more or less fixed pattern, which may be illustrated on the basis of a few dissertations from the 1920s and early 1930s. The author started by focusing on the *symptoms*: root rot caused by *Phycomycetes*, for instance,[18] or diseases caused by black moulds,[19] '*Pestalozzia*' diseases,[20] 'red nose' disease in beans,[21] or mortality in buds and stems of the raspberry.[22] He or she would analyze the symptoms using the classification scheme published in 1919 by Appel and Westerdijk, sometimes adding detailed observations garnered at first hand and discuss the subject in the context of the existing literature.

[15] Ibid., p. 27.

[16] Ibid., p. 28; Westerdijk leaves the college of agriculture in Wageningen out of consideration here.

[17] J. Westerdijk, 'Der Universitätsunterricht in der Pflanzenpathologie', *Angewandte Botanik, Zeitschrift für Erforschung der Nutzpflanzen*, vol. VI, no. 2, 1924, p. 42.

[18] C.J. Buisman, *Root rots caused by Phycomycetes*, PhD thesis Utrecht, 1927.

[19] P.C. Bolle, *Die durch Schwärzepilze (Phaeodictyae) erzeugten Pflanzenkrankheiten*, PhD thesis Utrecht, 1924.

[20] C.M. Doyer, *Untersuchungen über die sogenannten Pestalozzia-Krankheit und die Gattung Pestalozzia* de Not., PhD thesis Amsterdam, 1925.

[21] A. Brinkman, *De roodneuzenziekte van Phaseolus vulgaris* L., *veroorzaakt door Pleospora herbarum* (Pers.), PhD thesis Amsterdam, 1931.

[22] J.P. Karthaus, *Het afsterven van stengels en knoppen bij de roode framboos*, PhD thesis Utrecht, 1927.

The actual goal of this research was to establish a *causal relationship* between a particular fungus and the disease afflicting the crop. So the research question might be formulated in one of two ways. In one case it would be based on a specific fungus or group of fungi, and the question would be which diseases they cause and which they do not. Alternatively, the point of departure might be the diseased plant, and the question would be which fungus could or could not have caused the disease. Consequently, the main emphasis, including the way the report was written up, would be either on the mycological or the phytopathological part of the research.

In both cases, however, only a successful *infection experiment* would constitute conclusive proof of the causal relationship the research set out to establish. Anyone who omitted this part of the research – thus violating what had by then been formally accepted as Koch's Postulates – not only disqualified himself or herself as a phytopathologist, but brought the entire field into disrepute. 'In fact, the existence of [parasitism] can only be established after successful infection experiments have been conducted', Westerdijk insisted sternly to a layman – in this case, a biology teacher at the secondary school for agriculture. 'Now countless fungi have been identified as parasites since the end of the previous century and the beginning of this one, without such experiments being conducted. A great many saprophytes are still quite wrongly classified as parasites. The frequent occurrence of an organism on certain plants is no proof of parasitism.'[23]

The report of the procedure used for an infection experiment and of its findings is therefore central to these studies. Subsequently, depending on what had initially prompted the research – an enquiry sent in by a grower,[24] or a lack of clarity in the literature –[25] the author would conclude with recommendations for the control of the disease, or with the amendment or revision of the existing knowledge of the syndrome in relation to the fungus. No research was conducted in the Phytopathology Laboratory focusing specifically on bacteria as the possible cause of disease until 1932;[26] nor were viruses selected as the subject of separate infection experiments, even where they were suspected of

[23] Westerdijk to Fop. I. Brouwer, 22 March 1944, archives of the WCS.

[24] A. Pfälzer, *Het vrucht- en bladvuur van de komkommer, Cladosporium cucumerinum* Ell. en Arth. *en Corynespora melonis* (Cooke) L, PhD thesis Utrecht, 1927; Brinkman, op. cit. 1931; F.H. Feekes, *Onderzoekingen over schimmelziekten van bolgewassen*, PhD thesis Utrecht, 1931; W.F. van Hell, *Onderzoekingen over ziekten van lelie*s, PhD thesis Utrecht, 1931.

[25] K. Simon Thomas, *Onderzoekingen over Rhizoctonia*, PhD thesis Utrecht, 1925; Doyer, op. cit. 1925; Buisman, op. cit. 1927; A. Meurs, *Wortelrot, veroorzaakt door schimmels uit de geslachten Pythium* Pringsheim *en Aphanomyces* de Bary, PhD thesis Utrecht, 1928.

[26] E.J. Lindeyer, *De bacterieziekte van de wilg, veroorzaakt door Pseudomonas saliciperda n. sp.*, PhD thesis Utrecht, 1932.

being causative agents.[27] And in this entire early period, only one PhD thesis was completed, in 1930, that centred on an entomological subject, for all Westerdijk's optimism on this count.[28]

With the shift of accent in the research at the Phytopathology Laboratory, besides research into specific diseases and their possible causes, more systematic attention was paid to factors that can influence whether or not a plant becomes diseased. As Westerdijk told her audience on the occasion of Otto Appel's anniversary celebrations in 1924: 'Plant pathology in the broadest sense of the term is plant physiology, and it cannot be emphasized enough that the study of pathology requires a sound basis in physiology. Someone who has not undergone thorough training in anatomy and physiology should stay clear of pathology.'[29] Research projects now focused on the *pathological course* of diseases as well as the diseases themselves.

One example is the project conducted in 1931 by H.A. Diddens, who studied in detail the influence of acidity, elements of nutrition (nitrogen, potassium, calcium etc.), and the addition of copper sulphate on the infection of flax by the fungus *Pythium megalacanthum* de Bary.[30] Another is Rutger van der Veen's PhD thesis in 1930, on the relationship between the presence of salts and organic substances in the soil and the occurrence and course of a parasitic fungal disease.[31] Wilt diseases, he argued, generally resulted from root rot, or from the invasion of a parasite in vessels, which causes a blockage leading to wilting and ultimately to the plant's death. The invasive fungi live in the soil, where they feed on salts and organic material. Fungi secrete toxins – virulent fungi produce stronger toxins – and the literature shows that resistant plants are less sensitive to these toxins. Still, this left several questions unanswered: do fungi derive their virulence from the nutrients in the soil? If so, which ones? How does this relate to the resistance of plants? Van der Veen could not supply answers, but he observed that in order to understand the process, the interaction between all these factors had to be studied separately.

The thesis presented by C. Wehlburg in 1932, following a similar line of reasoning, established the relationship between the nutrition of the host plant

[27] See Karthaus, op. cit. 1927; Van Hell, op. cit. 1931.

[28] By H.C.C.A.A. Vos, *De invloed van Pseudococcus citri* (Risso) Fern *op de plant*, PhD thesis Utrecht, 1930; a few shorter pieces of research were completed, such as S. Leefmans and A. van Luyk, '*Dilophus vulgarismeig* als Schädling', *MPLWCS*, vol. 3, 1912.

[29] J. Westerdijk, 'Der Universitätsunterricht in der Pflanzenpathologie', *Angewandte Botanik, Zeitschrift für Erforschung der Nutzpflanzen*, vol. VI, no. 2, 1924, p. 42.

[30] H.A. Diddens, *Onderzoekingen over de vlasbrand veroorzaakt door Pythium megalacanthum* de Bary, PhD thesis Amsterdam, 1931.

[31] R. van der Veen, *Onderzoekingen over tracheomycosen*, PhD thesis Utrecht, 1930.

and parasitic disease in peas.[32] And in 1933 B.A. Tiddens reported her infection experiments with *Thielaviopsis* (Berk. et Br.) Ferraris on primroses, noting the different results she obtained when she varied temperature, moisture, and the soil pH value.[33] Did the fungus always cause root rot or did the degree of parasitism depend on the natural resistance of roots, so that the risk of infection increased with diminishing resistance?

The research projects still revolved around infection experiments, but there was far more attention than in the past for the conditions that fostered a successful result.[34] In fact conditions helped to determine whether a plant would become diseased or not, and must therefore be mentioned explicitly. For the first time, diseases caused by nutritional deficiencies or surpluses, and the regulatory influence of physical-chemical factors in the environment on the course of disease, were discussed explicitly – fulfilling the hopes that Westerdijk had expressed in her inaugural address, when she had mentioned one of the underdeveloped branches on the main trunk of phytopathology.

Besides these brief, individual research projects – each PhD thesis represented an average of three years' work, after which the person concerned would generally leave the Laboratory – Westerdijk's double professorship provided scope for longer-term, fundamental research. Her assistants, when their time was not wholly taken up with helping PhD students and preparing classes and lab sessions, could devote themselves to this kind of research. In addition, the Phytopathology Laboratory now had more space for researchers who were commissioned by third parties to carry out long-term projects. Finally, there was the research done by all these PhD students – of whom the laboratory now had almost twice as many as before – which was spreading Baarn's reputation to all corners of the earth. This led, in the course of the 1930s, to the emergence of several distinct research lines.

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32 C. Wehlburg, *Onderzoekingen over erwtenanthracnose*, PhD thesis Utrecht, 1932.

33 B.A. Tiddens, *Wortelrot van Primula obconica, veroorzaakt door Thielaviopsis* (Berk.et Br.) Ferraris, PhD thesis Utrecht, 1933.

34 Before this, some PhD students had already been paying more attention to the course of the disease process rather than merely seeking to establish causative factors. Several PhD theses completed in 1927 included sections on this subject: one looked at the physiology of root transpiration in relation to changes in the soil air; another analyzed a deficiency disease; and a third reconstructed the invasive process of a fungus in a host plant. See J.W.M. Roodenburg, *Zuurstofgebrek in de grond in verband met wortelrot*, PhD thesis Utrecht, 1927; J.C. s'Jacob, *Anorganische beschadigingen bij Pisum sativum* L. *en Phaseolus vulgaris* L., PhD thesis Utrecht, 1927; A. Pfälzer, *Het vrucht- en bladvuur van de komkommer, Cladosporium cucumerinum* Ell. en Arth. *en Corynespora melonis* (Cooke) L., PhD thesis Utrecht, 1927. Unlike later studies, however, the sections of these theses dealing with the influence of environmental factors were relatively brief and exploratory.

Elm disease

One of these lines of research was elm disease. Several consecutive women researchers, assisted periodically by students, conducted extensive research on elm disease in the 1930s, which was funded by the Committee for the Study and Control of Elm Disease.[35] These studies too consisted of several different research lines.

By far the most important and longest-lasting of these research lines was *susceptibility research*. It consisted of studies conducted by Christine Buisman, and later by Johanna Went, on the susceptibility of different elm species, varieties, and individuals. The researchers infected different elm species and collections of seedlings with *Graphium ulmi*, and if no symptoms had become apparent within four weeks, they infected the saplings again, sometimes up to four times in total. They then recorded the health of the tree.[36]

Again and again it became apparent that the severity of the disease depended on the weather, the virulence of the *Graphium ulmi* used, the age of the trees, and numerous other factors. Even so, some species proved to be more resistant than others. In contrast to European and American trees, for instance, the Asian species appeared initially not to be susceptible.[37] Later on, however, the Japanese elms too succumbed. Then Buisman and Went concentrated on European elms again: 'we kept trying to identify less susceptible specimens among the seedlings of common European elm species, which could eventually be used to replace our Dutch elms.'[38]

At the same time, Christine Buisman meticulously revised the *nomenclature* of the elm, 'since the different names currently in use at nurseries cause considerable confusion.'[39] Of great *mycological* importance was Buisman's discovery, in 1932, that *Graphium ulmi* Schwarz did in fact have a sexual form, as a result of which *Graphium ulmi* henceforth had to be assigned to the genus *Ceratostomella ulmi* (Schwarz) Buisman.[40] This did not have any consequences

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35 Comité inzake Bestudeering en Bestrijding van de Iepenziekte (CIBBI). The Committee derived its income from gifts and donations provided by municipal and provincial authorities, water boards etc. Its total income for 1931 came to 10,442 guilders, of which 3,990 was allocated to the WCS and 3,309 guilders to the Laboratory of Entomology in Wageningen.

36 J. Westerdijk, M.S.J. Ledeboer and J. Went, 'Mededeelingen omtrent gevoeligheidsproeven van iepen voor *Graphium ulmi* Schwarz, gedurende 1929 en 1930', CIBBI, Mededeeling no. 4, pp. 1-6.

37 'Verslag van de phytopathologische onderzoekingen over de iepenziekte, verricht in het Laboratorium "Willie Commelin Scholten"', CIBBI, Mededeeling no. 10, 1932.

38 C. Buisman, 'Verslag van de onderzoekingen over de iepenziekte, verricht in het Phytopathologisch Laboratorium "Willie Commelin Scholten" gedurende 1932', CIBBI, Mededeeling no. 13, 1933.

39 C. Buisman, 'Overzicht van de soorten iepen, in verband met het iepenziekteonderzoek', CIBBI, Mededeeling no. 4, 1931, p. 7.

40 C. Buisman, '*Ceratostomella ulmi*, de geslachtelijke vorm van *Graphium ulmi* Schwarz', *Tijdschrift over Plantenziekten*, 1932, pp. 1-8.

for the control of the disease, but the new genus became the source of inspiration for Marie Ledeboer's PhD thesis.

If *Ceratostomella* is sensitive to a particular substance or element, she reasoned, and we can discover which substance this is, we would increase our chances of eradicating elm disease. She went on to subject the fungus to a variety of temperatures, nutrients, sunlight, darkness and chemicals – but was eventually forced to conclude that 'no positive indications can be derived from my experiments as to the practical usefulness of any particular substance.'[41] It became clear that whatever harmed the fungus also harmed the elm.

A similar, *physiological* line of argument was used in the research into the possible influence of the speed of water transport on the course of elm disease,[42] and research into the relationship between the intensity of transpiration in different elm species and their susceptibility to elm disease. Buisman and Went conducted transport and transpiration experiments for several consecutive years. For the latter, they tried out a new method: they placed filter paper drenched in cobalt chloride on leaves of susceptible and less susceptible elms, and used the time taken for the blue paper to turn pink as the basis for determining the intensity of evaporation. However, the results did not point to any correlation between susceptibility to elm disease and transpiration.[43] That might have something to do with the particular method used, wrote Buisman, since diverse weather conditions had prevented the researchers from conducting the experiments on the right days.

After this, Buisman also introduced an *anatomical* approach to the problem. Under the microscope, the last growth ring of a branch that had been artificially infected with *Graphium ulmi* a few months earlier displayed several layers of flat starch-filled parenchyma cells. The appearance of these farinaceous layers proved that besides the plant's water transport being disrupted by the infection, the tree also displayed defence responses. Defining the factors that influenced the production of farinaceous parenchyma cells was extremely difficult, wrote Buisman, 'but the phenomenon in itself appeared to me to be important enough to mention.'[44]

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41 M.S.J. Ledeboer, *Physiologische onderzoekingen over Ceratostomella ulmi* (Schwarz) Buisman, 1934.

42 'Verslag van de phytopathologische onderzoekingen over de iepenziekte, verricht in het Laboratorium "Willie Commelin Scholten"', CIBBI, Mededeeling no. 10, 1932, pp. 17-20.

43 C. Buisman, 'Proeven over waterverdamping bij bladeren van verschillende iepensoorten', in: 'Verslag van onderzoekingen over de iepenziekte, verricht in het Phytopathologisch Laboratorium "Willie Commelin Scholten" gedurende 1932', CIBBI, Mededeeling no. 13, 1933, pp. 31-35.

44 'Verslag over de onderzoekingen betreffende de iepenziekte, verricht in het Phytopathologisch Laboratorium "Willie Commelin Scholten" gedurende 1934', CIBBI, Mededeeling no. 18, 1935, pp. 14-16.

In 1934/1935, when the evidence suggested that number 24, the seedling of *U. foliacea* from Spain, was not susceptible to the disease, Buisman intensified the infection technique. Together with the researcher J.J. Franssen of the Entomology Laboratory in Wageningen, she developed a way of making sure that the elm bark beetles could spread *Ceratostomella* in sufficient quantities; the most effective method proved to be making the beetles crawl across beer mats infected with *Ceratostomella*, Franssen discovered. The beetles infected in this way were then set loose in the crowns of trees wrapped in canvas covers, where they could eat to their hearts' content in their natural *Reifungsfrass*. The results of this infection technique were in general very similar to those obtained with infection by hypodermic needle, wrote Buisman, 'although we had the impression that … the symptoms that occurred after the beetle infection were more severe.'[45] Meanwhile, the inoculation experiments (in 1934 Dutch phytopathologists had agreed to use the term 'inoculation' instead of 'artificial infection'[46]) carried on as before.

On 27 March 1936, Buisman died, at just 36 years of age, before she could carry out her plan of extending the research on elm disease to include an enquiry along *genetic* lines. Johanna Went and Miss N. Krijthe continued this line of research: Went in Baarn concentrated on the mycological and susceptibility research, while Krijthe, at the Laboratory of Genetics in Wageningen, focused on hybridization studies.[47]

The Buisman family set up the Dr Christine Buisman Fund in memory of their daughter. The Fund would award a grant to a woman student of phytopathology or biology each year for a foreign study trip.[48] Buisman's name was also immortalized in 1937 by the Committee, which decided to rename elm no. 24, the only elm seedling that had thus far proved resistant to elm disease, the 'Christine Buisman Elm'.[49] 'This elm has held up excellently again this year', reported Went in 1938. 'Since 1932, grafts and layers of the "Christine Buisman" elm have been subjected to a total of 732 inoculations. In 13 cases

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[45] J.J. Franssen and C. Buisman, 'Infectieproeven op verschillende iepensoorten met behulp van iepenspintkevers', CIBBI, Mededeeling no. 19, 1935; in 1939, J.J. Franssen would be awarded a doctorate by the College of Agriculture on the strength of the thesis *Iepenziekte, iepenspintkevers en hun beider bestrijding*.

[46] C. Buisman, 'Verslag van de onderzoekingen over de iepenziekte, verricht in het Phytopathologisch Laboratorium "Willie Commelin Scholten" te Baarn gedurende 1935', CIBBI, Mededeeling no. 20, 1935, p. 2.

[47] N. Krijthe stopped her work at the end of 1940, but the research was continued by others.

[48] This fund still exists today. Although it is now formally possible for male students to benefit, in practice grants are always awarded to women students, unless none apply in a particular year.

[49] 'Verslag van den secretaris over het jaar 1937', CIBBI, Mededeeling no. 26, p. 1.

Westerdijk with assistants, 1937. International Information Centre and Archives for the Women's Movement.
Front row (from left to right): A. Jaarsveld, J. Westerdijk, T. Van Eek, H.C. Koning; Back row: A. Van Luyk, K. Hartsuyker, H. Diddens, J. Grosjean, G. Bunschoten, J. Lodder, J. Went, M. Goossen, H.F. Van Beyma thoe Kingma.

(1.9 %) they developed symptoms, and in 24 cases (3.2 %) they suffered mild damage. In not a single case, however, did they suffer any enduring harm. … In other countries too, good results have been achieved with this elm.'[50]

In 1938 the Committee estimated that almost 300,000 diseased elms had been destroyed in the Netherlands since 1930. Another 930,000 still remained.[51] By then the disease had spread as far east as Russia, and research teams were studying it in the United States and virtually every country in Europe. The term 'Dutch elm disease' should be scrapped, said Went, since no one had ever

[50] J. Went, 'Verslag van de onderzoekingen over de iepenziekte verricht in het Phytopathologisch Laboratorium "Willie Commelin Scholten" te Baarn gedurende 1937', CIBBI, Mededeeling no. 27, 1938, p. 10.
[51] F.W. Burger, 'Iepensterfte in Nederland', CIBBI, Mededeeling no. 28, 1938, pp. 11-12.

proved that the disease originated in the Netherlands; it might just as well have started in northern France.[52]

Johanna Went continued the hybridization programme in the Willie Commelin Scholten Phytopathology Laboratory in Baarn, in her quest for other resistant elms, until 1953, when Hans Heybroek took over. Although both always worked on commission for third parties,[53] and their names were never on the laboratory's payroll, this research nonetheless illustrates the shift of emphasis at the Baarn laboratory in the 1930s: while *disease* was still nominally at the heart of the phytopathologists' research, it was in fact the various specific aspects of the *disease process* that were studied, from the vantage points of physiology, anatomy, morphology, mycology and genetics.[54]

Poplar canker

A similar trend characterized the research on canker in poplars, another research line launched at the Phytopathology Laboratory in 1935. Poplar canker was attracting considerable attention, wrote Westerdijk, partly because of the need for poplar timber in new industries, and partly because of the growing interest in planting trees in general.[55]

Poplar canker aroused much the same commotion as elm disease had, ten years earlier. Once more, all sorts of ignorant views were bandied about, and there were fears, especially in the Federal Republic of Germany, of the tree dying out altogether. Again, possible causes abounded in the international literature, none of which, observed Westerdijk pointedly, 'had been shown with certainty in experiments to be possible causative agents of this disease.'

In this case, unlike elm disease, however, it soon became clear that there were several different forms of poplar canker, which were probably attributable to different causes. In the Netherlands it was the Heeswijk white poplar that was being attacked most severely by rampant, sometimes tumour-like, cankers, as well as cankers in the form of open wounds with callus edges. In

[52] J. Went, 'Compilation of the investigations on the susceptibility of different elms to *Cerastomella ulmi* Buisman in the Netherlands', *Phytopathologische Zeitschrift* vol. XI, no. 2, 1938, p. 181.

[53] Until 1946 the work was paid for by the CIBBI. After this, the CIBBI was incorporated, as the sister committee of the Committee for the Study and Control of Insect Pests in Forests, into the Institute for Applied Biological Research in the Natural Environment, attached to the TNO; in 1954 the financial responsibility for the research passed to De Dorschkamp Forest Research Station.

[54] When the research on disease processes was widened to include research on the behaviour of diseased plants in general, in the early 1960s, the name 'elm disease' was also dropped from the research title. Subjects hitherto discussed under the heading of 'elm disease' were incorporated into the programme of the research group 'resistance mechanisms in vascular parasites'.

[55] J. Westerdijk, 'De Populierenkanker', *Tijdschrift der Nederlandsche Heidemaatschappij* no. 12, 1937.

France, bacteria were described as the cause of poplar canker. The Italian poplar was susceptible to open wounds and tubercles, in combination with twig dieback, possibly after frost damage. A third poplar exhibited tubercles, 'which might perhaps be called closed cankers.' In 1924, Westerdijk and her permanent assistant A. van Luyk had already established that different fungi species belonging to the genus *Nectria* occurred in poplar cankers, but 'this research had focused more on the fungi than on the symptoms', wrote Westerdijk. In short, there was an urgent need for fundamental research on the subject. The Netherlands Land Development Society and the Provincial Water Distribution Company of North Holland agreed to fund it.

When Dr Jet Koning was assigned this research project by Westerdijk in 1935, the first thing she did was therefore to define the term 'canker' more precisely.[56] She then went on to conduct a number of inoculation experiments to establish the causes of the different cankers.

After a visit to France, where in-depth research on poplar canker had been conducted for some time, and in collaboration with a number of French researchers, she then focused her attention on 'the most significant form of canker in poplars'[57], namely bacterial canker. She established the physiological features of the bacteria concerned, *Pseudomonas rimaefaciens* n.sp., and investigated whether specific nutritional conditions influenced the development of this canker in the tree. At the same time she continued her research on the susceptibility of different poplar species, 'as far as both bacterial and fungal cankers were concerned.' And just as for elm disease, a quest was begun at the same time to find more resistant poplars.[58]

Although this research was nominally confined to a study of poplar disease, in practice it increasingly focused on the processes underlying the occurrence of the disease: the influence of nutrition, soil and weather conditions, and the properties of the pathogen. Thus, the disease was gradually redefined: instead of a condition affecting a tree, it was described as a consequence of the interaction between the host plant, the pathogen, and conditions. Once the pathogen had been identified, it became possible to gain a better understanding of the nature and dynamics of this interaction – a shift of focus that was not conclusively effected in Baarn until after the Second World War.

A key role in this shift of focus was played by Van Luyk's *antagonism research,* the Phytopathology Laboratory's third research line.

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[56] H.C. Koning, 'The bacterial cancer of poplars', *MPLWCS*, vol. 14, 1938, pp. 1-42.
[57] WJPLWCS for 1937, p. 4, archives of the WCS.
[58] WJPLWCS for 1939, archives of the WCS.

Antagonism research

Van Luyk, who started out as a farmer on the island of Tholen, in the Dutch province of Zeeland, had been appointed as an assistant at the Phytopathology Laboratory back in 1910, at the age of 36. A diligently self-taught scientist – 'he had probably devoted every evening of his life to scientific work', wrote Westerdijk after his death –, his studies and years of work at the laboratory, in part under her supervision, had shaped him into a highly competent and dedicated researcher.[59]

Tradition has it that the later acclaimed antagonism research began when he was looking out of one of the Villa's towers one day and was struck by some attractive concentric discolorations in the grass. According to the Scientific Report for 1931, however, it was the other way round. 'Van Luyk launched a major research project on the necrosis of patches of grass in a golf course', it states. 'When the project was under way, the same phenomenon was found in our lawns.'[60]

Which observation came first scarcely matters. The interesting point is the way in which the research developed: here too, it was a practical problem, in this case bare patches in golf courses (an annoyance for the rapidly swelling ranks of golf enthusiasts), that justified the launch of a research project, and again it was the internal dynamics at the laboratory that helped to ensure that the actual disease (and its control) faded into the background, while attention focused instead on the mechanism underlying the genesis of disease.

Van Luyk started off along classical lines. He isolated several species of fungi from the roots of rotting grasses. He then conducted infection experiments. As expected, he gained positive results with different species. Far more unexpected, however – and hence more interesting – was the observation that 'a higher percentage of the grass seed germinates in non-sterile soil. It therefore appears that soil organisms have a favourable influence.'[61] Van Luyk summarized: 'It has become clear over the past few years that an antagonistic effect can arise between various soil organisms. To clarify this antagonism further, experiments were now conducted with several fungi in pure culture.'

In 1934, when Van Luyk published *Untersuchungen über Krankheiten der Gräser* ('Study of Diseases of Grass'), he continued to say that his research had been prompted by ugly patches in golf courses, but his focus had shifted to the striking difference in the germination of seeds depending on whether the soil was sterile or non-sterile, something that is obviously only visible in the laboratory. 'If germination is fostered by seed or soil fungi, the growth and perhaps

59 J. Westerdijk, 'Dr. A. van Luyk', *Vakblad voor Biologen*, no. 9, 1950, pp. 153-154.
60 WJPLWCS for 1931, p. 3, archives of the WCS.
61 WJPLWCS for 1933, p. 5, archives of the WCS.

also the virulence of the parasitic fungi could be stimulated,' wrote Van Luyk. 'The way in which this stimulation is achieved is an important and interesting problem. We cannot rule out the possibility that saprophytic fungi can improve the absorption of various nutrients by plants and parasitic fungi.'[62]

In the years that followed, the Laboratory's annual reports would always begin with Van Luyk's research; initially under the heading of 'Root rot in grasses', but from 1938 onwards it was referred to simply as 'Antagonism between fungi'[63], or, more generally still, 'Antagonism between micro-organisms.'[64] This was the culmination of the shift of emphasis away from a disease and its symptoms towards a subject of pure scientific interest – without making a permanent mark on the Laboratory's work, however, since when Van Luyk retired in December 1939, this antagonism research also vanished from the Phytopathology Laboratory, not to return until the 1970s.

Gerda Bunschoten's PhD thesis was of prime importance to Van Luyk's research, since she had established in minute detail the relationship between pure culture in which fungi were cultured and their virulence.[65] But Van Luyk's curiosity focused on something quite different: the fact that inoculations in non-sterile soil yielded fewer results – sometimes none at all – than those in sterile soil. This was well documented in the literature, he wrote in 1938. '[I]t is however a less generally known fact, that the addition of other parasites will counteract the original parasitic influence. These results induced me to take up the question of antagonistic and synergetic influence between soil parasites and saprophytes.'

What did Van Luyk discover? Take a specific parasite – *Pythium volutum*, for instance. If it comes into contact with a grass species on a sterile substrate – *Agrostis stolonifera* in a test tube, say – 92 % of the grass blades will die. The other 8 % remain healthy. But add a drop of soil suspension – the soil in which the grass species generally flourishes – and 52 % of the glass blades will remain healthy. There were no parasites in that drop other than *Pythium*: so the effect was ascribable to antagonistic organisms.[66] 'In most cases the antagonistic action is certainly based on the formation of inhibiting substances, which having dissolved in the soil-moisture, have spread all over the soil', wrote Van Luyk.[67] But what were these antagonistic organisms?

[62] A. van Luyk, 'Untersuchungen über Krankheiten der Gräser', *MPLWCS*, vol. 13, 1934, pp. 1-28, esp. p. 28.
[63] WJPLWCS for 1934, 1935, 1936, 1937, 1938, archives of the WCS.
[64] WJPLWCS for 1939, archives of the WCS.
[65] G. Bunschoten, *Invloed van de voeding op de virulentie van schimmels*, PhD thesis Utrecht, 1933.
[66] A. van Luyk, 'Antagonism between various micro-organisms and different species of the genus *Pythium*, parasitizing upon grasses and lucerne', *MPLWCS*, vol. 14, August 1938, pp. 43-83, esp. p. 61.
[67] Ibid., p. 66.

In various experiments it was constantly a *Penicillium*, Van Luyk noted, that produced 'inhibiting substances' in such large quantities that pure *Pythium* would no longer grow in an Erlenmeyer flask.[68] This *Penicillium* was identified, in a small research project conducted by Dr F.H. van Beyma thoe Kingma of the Central Bureau of Fungal Cultures (CBS), as belonging to the group *Penicillium expansum*.

Van Luyk investigated the phenomenon further, seeking to define the conditions in which the *Penicillium* would have the strongest growth-inhibiting effect on *Pythium*. He established experimentally that the addition of saccharose 'as carbon-source' enhanced the effect. The strongest effect was produced if a 4% solution of saccharose was added to a 41-day old strain of *Penicillium*. The inhibiting substance was probably a metabolic product of the carbon source, concluded Van Luyk.[69]

Only one example of a toxic effect of a comparable strength was known in the literature – a discovery made by the British microbiologist Alexander Fleming. Van Luyk wrote that in 1929, Fleming too had discovered a powerfully antagonistic effect of a fungus in relation to certain bacteria. Fleming's fungus too was a *Penicillium*; it had destroyed the growth of the human pathogenic bacteria *Streptococcus pneumoniae* with a 4% glucose solution.

Van Luyk had no inkling of the practical implications of his own discovery any more than Fleming had had of his own in 1929. He did not get much further than making a few methodological recommendations. Environmental factors, such as temperature, moisture, pH, and most importantly the presence of some 'nitrogen and carbon sources' were all crucial to the degree in which a micro-organism can produce toxins, he wrote. In inoculation experiments, it was therefore of vital importance whether only the parasite itself was administered or it was administered together with the culture medium. The age of the medium was also of great importance. The degree to which the antagonist could form 'inhibiting substances' was partly dependent on this.

Something similar applied to the control of plant diseases. If the antagonism was to work, the environmental factors as well as the antagonistic organisms had to be adjusted. A minor variation on this was the possible application of the 'metabolic products of *Penicillium expansum*' to disinfect the soil. If these were added to the soil a few days before sowing, they might prevent an attack of soil pathogens, without jeopardizing the normal development of the seeds. The disinfectants that were commercially available at that time had the disadvantage of being harmful to the seed too – growers had to wait until

[68] Ibid., p. 69.
[69] Ibid., p. 71.

all disinfectant had been washed away (which meant that the harmful soil pathogens might well have returned!) before sowing.

'Probably more extensive investigations will bring to light that more micro-organisms are capable of forming inhibiting substances, just as strong or even stronger than the *Penicillium* of Fleming or *Penicillium expansum*', concluded Van Luyk. 'It is also to be expected, that besides mono- and disaccharids, all sorts of carbon combinations will prove practical for use. In this connection we may mention in the first place all sorts of products of refuse from industries. Besides fungicides and bactericides we will probably be able to isolate all kinds of other valuable substances from these products of refuse: a vast field of work for microbiologists and for the industries concerned.'[70]

Together with Victor Koningsberger, who from 1935 was Went's successor as professor at the Botany Laboratory in Utrecht, Van Luyk worked with grim determination in the wartime years on the production of an antibiotic, which made its promising entrance on the medicinal drugs market in October 1945, under the name 'Expansine'.

'**Research work that defied the terror**!' the advertisement shouted at its readers. 'On 21 February 1944, the first Dutch antibiotic, **Expansine**, was obtained in crystalline form. In 1945, bacteriological research showed that Expansine is active in relation to both Gram-positive and Gram-negative bacteria, in contrast to PENICILLIN, which affects only Gram-positive bacteria, albeit more powerfully than Expansine. Clinical research has shown that Expansine has a powerful effect on skin mycoses. The large-scale manufacture of EXPANSINE-OINTMENT is in preparation.'[71]

Two months later, Alexander Fleming, Ernst Chain and Howard Florey received the Nobel Prize in Physiology and Medicine for the discovery of penicillin. Quite soon afterwards, it became clear that Van Luyk's magic potion Expansine had too many harmful side-effects to be admitted to the international medicines market as a general antibiotic. Unlike penicillin, it never reached the stage of life-saving drug. It remained an ointment used to get rid of fungal skin infections.

On his retirement in 1940, Van Luyk was awarded an honorary doctorate by Utrecht University. He died in 1950.

The Phytopathology Laboratory in wartime

On 11 August 1945, Westerdijk was interviewed by the Committee for the Restoration and Purification of Utrecht University. There is nothing in the

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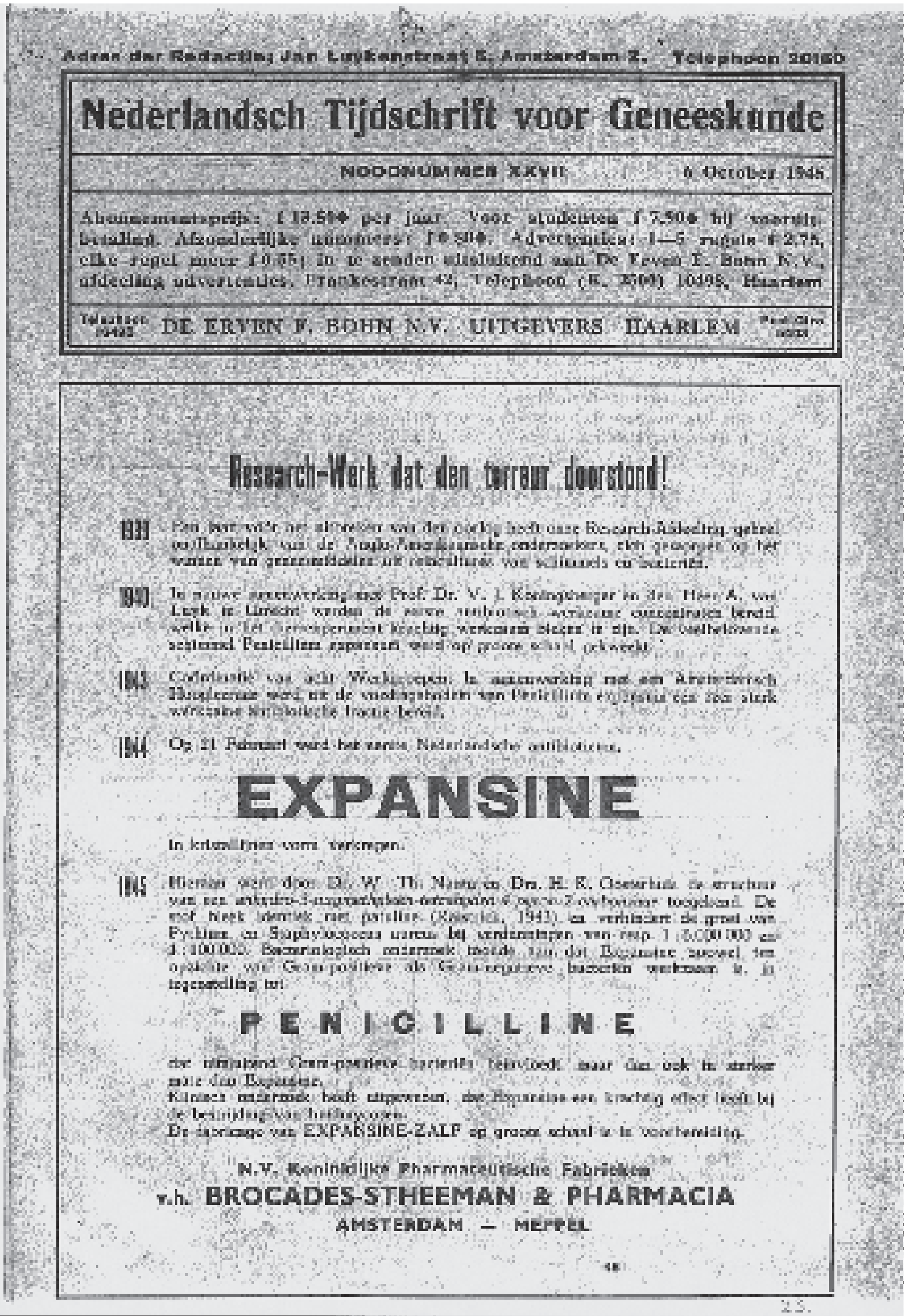
70 Ibid., p. 82.

71 Title-page of the *Nederlandsch Tijdschrift voor Geneeskunde*, special issue XXVII, October 1945.



Advertisement for expansine. *Nederlandsch Tijdschrift voor Geneeskunde*, 1945.

files to indicate the reason for this interview, nor is there any indication of the subjects discussed on that occasion; the subject-matter can be reconstructed, however, to some extent.[72]

Like her colleagues at Utrecht University, Westerdijk had filled in the compulsory questionnaire that was issued to all members of staff in June 1945.[73]

1. Had she been a member of the SS, NSDAP, or NSB?[74] *No.*
2. Had she accepted any new position during the occupation? *No.*
3. Had she remained at her post after conditions had changed to such an extent that national interests were being undermined? *No.*
4. Had she taken over the duties of anyone who had lost their position as a result of a German measure? *No.*
5. Had she maintained contact with Germans for the benefit of her academic work? She had been in contact with Professor G. Gassner, Magdenburg, '*one of the few university rebels, who had been exiled for 8 years (in Turkey) and returned afterwards*'.
6. Had she worked for any German institution? *No.*
7. Had she adopted any particular position regarding the declaration of loyalty, or made any recommendations in this regard? '*Students work in my institute (which is not attached to any university) only from 1 June to 1 November. No lectures have been given since 10 March 1943. As a matter of fact there has been no contact with students at all since then, other than contact initiated by students who had gone into hiding.*'
8. In relation to the obligation for students to register introduced on 6 May 1943: had she taken a position or made any recommendations? '*Given my extensive duties, not possible to get in touch with them (see 9)*'
9. After 6 February 1943 [raids on students after the attack on the Dutch collaborator Seyffardt, after which they had been forced to sign a 'declaration of abstention'] and 6 May [when all students who had not signed the 'declaration of loyalty' were ordered to report to be sent to work in Germany], had she taught 'loyal' students? '*Said that I would have been prepared to talk about possible lessons with students, in fact no one showed up. To my regret, I never had*

[72] The 'College tot Herstel en Zuivering van de Rijksuniversiteit Utrecht', one of several committees set up after the war to examine the conduct of public servants during the occupation. UA item 59 CC, UU, inv. 2884 'Zuivering Westerdijk'. All documents relating to the investigation of Westerdijk's wartime conduct come from this file.

[73] For more general information on the way in which the Netherlands dealt with these issues after the war, see P. Romijn's excellent study, *Snel, streng en rechtvaardig: De afrekening met 'foute' Nederlanders*, 2nd ed., Amsterdam, Olympus, 2002 (orig. 1989).

[74] NSDAP = National Socialist German Workers' Party or Nazi Party; NSB = National Socialist Movement, the Dutch Nazi party.

an opportunity to do so, partly because of the subject being separate and the isolated location. If any students had shown up, there would only have been discussions; certainly no lab work in Baarn or lectures in Utrecht.'

10. Had she provided assistance to people who had gone into hiding? '*Appointed Miss. S. Dudok de Wit to work for the CBS.*'
11. Had she signed any of the following:
    – The Senate motion of 22 March 1943 [which gave students permission to sign the declaration of loyalty, but did not press them to do so, and which urged the occupying forces to withdraw the declaration of loyalty in full]: *yes.*
    – The Senate motion of 13 April 1943 [which urged a delay before non-signers be sent to work]: *yes.*
    – The joint letter of protest in March 1944: '*probably condemned it as pointless, but can no longer ascertain.*'

Whether these responses were the sole basis on which her lectures were suspended for the time being is not clear. But she did have to appear to account for herself orally.

There is no mention of Westerdijk's name in the archives of the University of Amsterdam, which followed a different procedure. Unlike the Utrecht committee, which elected to call *all* members of staff to account for their actions – including those who had 'obviously been on the right side' (such as Koningsberger) and who did not fill in the questionnaire, or did so with manifest distaste[75] – the Amsterdam Committee for Restoration and Purification interviewed only those whose behaviour, as indicated by matters of general knowledge, complaints received, or its own investigations (the Committee pursued its own lines of enquiry, including studying the minutes of meetings) appeared to call for clarification or justification. Although the student resistance – the harshest judges, as one would expect – blamed Westerdijk for 'failing to take a stand on the signature question, and for appointing a signatory as an assistant in the spring of 1943',[76] this was not sufficient to prompt the Committee to study her file or to take any measures.

The matter on which the Utrecht Committee wanted to interview her was primarily concerned with her role as director of the Central Bureau of Fungal Cultures (CBS). An undated and unsigned note in her file in the archives indicates the general drift of these talks.

[75] S. van Walsum, *Ook al voelt men zich gewond*, *De Utrechtse Universiteit tijdens de Duitse bezetting 1940-1945*, Utrecht, UU, 1995, p. 142.

[76] Assessment by the student resistance of members of the FWN, undated, GAA 279, CC, inv. 368, 'Stukken betreffende het beleid van het College tot Herstel 1945-1946'.

After reports of the American penicillin research had reached the Netherlands and Germany, the note reports, German researchers too tried to produce the magic remedy. The Dutch research effort in this area went underground. The Germans contacted the CBS and demanded strains from the fungi *Penicillium notatum* and *Penicillium expansum*. Westerdijk had sent them these strains, after first checking that they had lost the power to kill bacilli. The Germans had been unable to get anywhere using these strains.

Recent years have witnessed the publication of a small but steady stream of publications exploring the mutual relationships between the Dutch, German and Anglo-American penicillin research in this period. The success story has always been described unequivocally and in great detail as that of Fleming, Chain and Florey.[77] In the decisive battle for penicillin, the story goes, it was these three men who managed to increase penicillin production, in the spring of 1944, to some 100,000 million units a day – enough to eventually be able to treat all Allied military casualties on D-day, and enough to inspire confidence to attempt the landing on the coasts of Normandy. The rest is history.

But as in all such matters, that is not the whole story. At the same time as their quest, reports Marlene Burns, a small Dutch research team was also working on the production of penicillin in the wartime years, in conditions of utmost secrecy.

'When Germany occupied the Netherlands during World War II, a team at the Netherlands Yeast and Spirits Factory (NG&SF) secretly isolated, characterized, and produced penicillin – working under the code name Bacinol', she writes.[78] 'This 18-month project, which was completely independent of the acclaimed American and British efforts to produce penicillin, was conducted under far more challenging circumstances, without access to the scientific literature, corroborating data, and much in the way of valuable fermentation equipment. Moreover, amid the roundups and deportations taking place throughout western Europe, a Jewish physician, who was interned in a transit camp, provided key information to help the NG&SF team effort. Although this story is little known, parts of its narrative are more like components of a thriller than an undertaking in industrial microbiology.'

The Netherlands Yeast and Spirits Factory enjoyed protected status during the occupation, writes Burns. Its employees were exempt from deportation to work in Germany, because their knowledge and expertise were indispensable

77 *Inter alia* in G.H. Hobby, *Penicillin: Meeting the challenge*, Yale University Press, 1985.

78 M. Burns, J.W. Bennet and P. W.M. van Dijck, 'Code Name Bacinol', *ASM News*, vol. 69, no. 1, 2003, pp. 25-31, esp. p. 25.

to food production in the Netherlands. And 'the one German guard who was assigned to oversee the Delft factory was not skilled in microbiology and could not distinguish the paraphernalia used for routine fermentation processes from that which was used for the clandestine penicillin research project. Moreover, he liked to drink, and management made sure he was given generous helpings of Jenever.'

Exactly how the news of the Anglo-American penicillin research reached Delft is unclear, writes Burns. Some sources maintain that the information floated down from the sky in the summer of 1943, in pamphlets dropped by British bombers, while others say the news was broadcast on the wartime programme Radio Oranje. Whatever the case may be, 'it was compelling enough to convince Waller [director of research] that NG&SF should try [to] make this wonderful new fermentation product.'

It was a tall order, writes Burns. This was a time of scarcities, besides which researchers were unable to consult the international literature. But Delft had one major advantage: access to the world's best collection of fungi, the CBS. 'In fact the first archival evidence of the secret penicillin research consists of dealings with the CBS. A letter of 19 January 1944 from CBS director Johanna Westerdijk to J. Rombouts at NG&SF says: "By this mail we send you the *Penicillium* and *Aspergillus* cultures. Please return the empty blocks, we are not able to get any new blocks at this moment."'[79]

This was not the CBS's only contact with Delft;[80] a month later, Westerdijk passed on a list of literature dealing with penicillin research to the director of TNO. She wrote: 'There is a good compilation with literature concerning penicillin in *Klinische Wochenschrift* vol. 22, nos. 32-33: M. Kiese, "Chemotherapie mit antibakteriellen Stoffen aus niederen Pilzen und Bakterien". The article by Abraham et al. is cited for the preparation of this chemical.'[81] Westerdijk also refers to other articles, including the original one by Fleming.

'This article [the one by Kiese, 1943], which contained abstracts of penicillin-related papers that were published by the Oxford group between 1940-1943, ultimately proved the most useful source of information for the Delft scientists', writes Burns. The Delft researchers tried to duplicate Fleming's results, she continues, but were unable to do so. They then switched to a different method for obtaining the bactericidal effect in a Petri dish, and did achieve the desired result. The fungus with the greatest bactericidal capacity was coded

79 Ibid., pp. 27-28.

80 Burns was unable to disclose this information, since the letter concerned is in the archives of the WCS, which was not yet accessible to the public when she was conducting her research.

81 Westerdijk to TNO, 15 February 1944, archives of the WCS.

‘P-6, *Penicillium baculatum* Westling.’ They called the antibacterial chemical Bacinol; ‘The code name also helped ensure that the Germans would remain unaware of the true nature of the clandestine research.’

In June 1944 they had succeeded in extracting a small quantity of an estimated 50%-pure Bacinol. ‘Convinced that they were on the right track, the members of the Delft team quickly considered how to scale up Bacinol production’, writes Burns. At some point in the summer of 1944, the Delft team received some unexpected help from the Jewish physician A. Querido, who had been interned in Westerbork camp. The management of the factory NG&SF had classified him as ‘an essential member of staff’, on which basis he was permitted to go to Delft once a month to attend meetings. ‘While changing trains on one of those trips, he met with a colleague from the University of Amsterdam who told Querido that a recent visitor from neutral Portugal had brought a Swiss medical journal with an article by A.Wettstein on penicillin. Querido brought the borrowed publication to NG&SF for copying, providing further corroboration that the Delft team was on the right track.’

Burns relates that towards the end of the war, in April 1945, the Allies dropped food and medicine, including penicillin. An NG&SF employee managed to get hold of a few ampoules of it. ‘Scientists at NG&SF immediately began comparing the contents of those ampoules to Bacinol. When the war in Europe ended a few weeks later, the liberation was made even sweeter for the members of the Delft team when they verified that “Bacinol” was indeed penicillin.’ The Delft team carried on working with its P-6 strain of *Penicillium baculatum* after the war’, writes Burns, ‘noting that it compared favourably to other penicillin-producing strains of *P. notatum* and *P. chrysogenum* that were obtained from CBS.’ But ‘eventually, NG&SF, like all penicillin manufacturers, switched to using a higher-yielding derivate of the Peoria strain NRRL 1951.’

The factory did not do at all badly out of this project. ‘By 1946’, relates Burns, ‘NG&SF was supplying all the penicillin needed by Dutch hospitals; by 1948, it was supplying all the penicillin needed for the entire country; and by 1949 it began exporting penicillin. Eventually, NG&SF became one of the world’s largest penicillin producers.’

Burns’s story does have ‘components of a thriller’, but it leaves a number of interesting questions unanswered. To help arrive at an assessment of the research done at NG&SF, it would be helpful to know whether the Delft team was familiar with the work being done by Koningsberger and Van Luyk in Utrecht. Were there other research teams working in secret? In addition, to assess Westerdijk’s role in the penicillin research, we need to know whether she did in fact occupy a pivotal position in the continental penicillin research. If so, how important were the fungal strains she provided?

The Delft researchers, as has now become generally known, were not the only ones who were trying to isolate an antibiotic from strains of *Penicillium*. In his book *Een kwetsbaar centrum van de geest, de Universiteit van Amsterdam tussen 1935 en 1950* ('A vulnerable centre of the intellect: the University of Amsterdam between 1935 and 1950'), the Amsterdam historian P.J. Knegtmans reconstructs with great precision the way in which the University of Amsterdam weathered the war.

In September 1944, writes Knegtmans, most of the university's laboratories found their gas and electricity supplies had been turned off. From then on, research of no immediate clinical application could only be conducted if it did not require the use of electricity. Certain pieces of apparatus could no longer be used, and instruments had to be cleaned chemically or with steam. The only laboratory allowed to continue using electricity was that of the famous chemist B.C.P. Jansen, who was studying the nutritional value of foodstuffs – but also, Knegtmans tells us, doing research on penicillin.

Together with Amsterdam's health service (GG&GD) and institutes attached to the universities of Leiden and Utrecht and the Free University in Amsterdam, Jansen set out to isolate chemicals from fungi.[82] The researchers were probably unaware that this research had also been resumed in the free world when they began, writes Knegtmans. They pursued a course of their own, carrying on where Van Luyk had left off. In 1944 they wrote in the *Nederlandsch Tijdschrift voor Geneeskunde* that 'Expansine', prepared from the fungus *Penicillium expansum,* strongly inhibited the growth of micro-organisms. They were familiar with the content of an issue of the *Schweizerische Medizinische Wochenschrift* that had been copied by a colleague working in Poland, Van Creveld, and A. Querido in Delft.

Did the Delft researchers know what Van Luyk and the others were working on? Given the history of the clandestine dissemination of the article from Portugal, it seems likely. But seeing that everyone was working with different strains, and communication must have been difficult, this would have had little impact on the progress of their respective projects. And Van Luyk was aware of Expansine's antibiotic properties long before the outbreak of war.

What about Westerdijk? Did she know what everyone was working on? She was in contact with B.C.P. Jansen, although there is no proof that she supplied him with any *Penicillium* strains. She did ask him, however, when he ordered some *Pythium mamillatum*, what he wanted to use the fungus for: 'I should like to know for what process you wish to use the *Pythium mamillatum*? There are

[82] P.J. Knegtmans, *Een kwetsbaar centrum van de geest, de UvA tussen 1935 en 1950,* Amsterdam, Amsterdam University Press, 1998, pp. 205 ff.

references in the literature to *Pythium* species that secrete pectase and thus supposedly destroy pectins in solutions. I know of no reference in the literature, however, specifying which species have this property. Could you inform me on this matter? I would be most grateful.'[83] But it is questionable whether she was aware of B.C.P. Jansen's penicillin research. She did know about the research being done in Delft, however; besides supplying the Delft team with fungal strains, she also gave them information that Burns refers to retrospectively as crucial.

What about Van Luyk and Koningsberger? Westerdijk knew Koningsberger well. They met at least once a year at the board meetings of the WCS. She also corresponded with him when he was interned in St Michielsgestel – but the letters in the archives do not contain any references to penicillin.[84]

It is unclear whether Westerdijk was able to continue freely using her telephone. In March 1944, she approached the local *kommandant* in Baarn, in her capacity as the director of a number of important institutes, for permission to use a telephone. In clarifying the importance of telephone contact to her institutes, she stated: 'Central Bureau of Fungal Cultures, a foundation that possesses the only collection of pure cultures of fungi that is used by Dutch, German and other European countries for their industries (food factories, breweries, chemical industries etc.). The procurement of materials for these enterprises, negotiations with representatives of German industries, in which rapid negotiations are of the essence, require the use of the telephone. Phytopathology Department of Utrecht University: wishes to contact the university (university authorities in the city of Utrecht).'[85] There is no reply to this request in the archives.

So there is no direct evidence that she knew about the Expansine research being done in Utrecht. But given Van Luyk's background, Westerdijk should have been able to surmise what he was up to. Westerdijk's close associate at the CBS, Dr F.H. van Beyma thoe Kingma, would also have been able to make an informed guess: it was he who had identified *Penicillium expansum* for Van Luyk in 1937. But he was also, as Westerdijk put it, 'regrettably on the wrong side'[86], and therefore her Achilles' heel.

Several sources confirm that Van Beyma thoe Kingma undertook regular trips to Germany during the war, to take part in talks about the transfer of the CBS, lock, stock and barrel, across the border. '*Jonkheer* Van Beyma, a fervent

[83] Westerdijk to Jansen, 15 November 1943, archives of the WCS.

[84] Koningsberger to Westerdijk, 7 April 1943; Westerdijk to Koningsberger, 12 April 1943, archives of the WCS.

[85] Westerdijk to *Ortskommandant* (local *kommandant*) Baarn, 1 March 1944, archives of the WCS.

[86] Westerdijk to Verdoorn, 28 October 1946, archives of the WCS.

friend of Germany who was deployed in the Dutch *Landsturm* [irregular military forces]', states a document from the German national archives in Berlin, 'came to Germany on 1 January 1945 and is prepared to continue his work here.'[87] Certain letters, which were traced by Huub van der Aa, a former employee of the CBS, show that Van Beyma was convinced of the need to move not part of the collection but the entire CBS to Germany. Dr Charlotte Thielke wrote to him in 1999, 'I cannot prove with documents that there were plans to move the CBS to Germany, to this institute [Institut für Mikrobiologie, Schott-Zeiss-Institut Jena] … But I remember very clearly that Mr F.H. van Beyma thoe Kingma wished to move matters in that direction. He visited the Institute in Jena, to inspect the space and to discuss details with Herr Knöll [the then director]. This was probably in February or March 1945.'[88]

Letters from Van der Aa's private archives make it possible to track the progress of this plan. One is from Professor H. Heinecke from Jena, who investigated this Dr Hans Knöll. Heinecke wrote to Van der Aa in 2000 that he had received Knöll's reply to a question posed by Professor Paul Rostock – head of medical research in Berlin, who was trying in that capacity to coordinate the German penicillin research – as to whether he could perhaps accommodate the CBS in his own laboratory.[89] Knöll's reply to the letter from Rostock (which has not yet been found) states: 'Having devoted considerable thought to the proposal for moving the Central Bureau of Fungal Cultures to Germany, I decided that this proposal is misguided. In my view it would be impossible, on technical grounds alone, to move the institute with its staff to Germany. Even in peacetime, a transfer of this kind would scarcely be technically feasible. Besides this, it would scarcely be possible to persuade the Dutch scientists and assistants to move voluntarily. To exert force, on the other hand, I deemed counter-productive.'[90]

In the end, the CBS remained in Baarn. But Van Beyma's constant presence there – he is said to have come to work wearing a uniform and heavy boots and to have stamped about the Villa so ferociously that the wooden floors groaned in protest – compelled Westerdijk to exercise caution.

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87 Bundesarchiv Berlin (SS Ahnenerbe) NS 21/845. With thanks to Dr Falk Müller, Johann Wolfgang University, Frankfurt am Main, who passed this document on to me.

88 Dr Charlotte Thielke to Van der Aa, 1 October 1999, private archives of Van der Aa – copy deposited in the archives of the WCS.

89 Heinecke to Van der Aa, 3 August 2000, private archives of Van der Aa – copy deposited in the archives of the WCS.

90 From H. Heinecke: 'Dokumente zu den Anfängen der penicillin-Forschung in Deutschland, Sonderschriften der Akademie gemeinnütziger Wissenschaft zu Erfurt', Sonderschrift 2000, Im Druck, Letter no. 13, 6 December 1944, private archives of Van der Aa. It is clear from the way this story ends that other attempts to move the CBS to Germany also came to nothing.

Was Westerdijk of pivotal importance in the continental penicillin research? Another researcher interested in the historical background, Dr Gilbert Shama of the Department of Chemical Engineering of Loughborough University in Leicestershire, England, discovered letters showing that Westerdijk did in fact supply *Penicillium* strains to Germany.[91] One of them dates from July 1944.[92] In this letter, *Oberstarzt* Eugen Haagen, Director of the Hygienic Institute of the Reich University of Strasbourg and Consultant Hygienist for the Luftwaffe – and as such a mere handshake's remove from Hitler – asked Westerdijk to send him strains including *Penicillium notatum* Westling and *Penicillium puberlum* Bainier. Westerdijk's answer is unknown. But Haagen's reply is not: 'Thank you for your kind letter of 11 August 1944 announcing that the strains have been despatched. Since you were kind enough to point out that the *Pen. corylophilum Dierekx* and *Pen. expansum* (Link)Thom produce a higher yield of antibacterial substances than the other fungi, I would like to place a supplementary order for both these strains.'

The timing of this request is remarkable. According to recent publications regarding the Germans' share in the research on penicillin, it was only then that the production of penicillin was elevated to a national top priority. 'Not until the middle of 1944 does it appear to have dawned on the national authorities that penicillin research represented an extraordinary military development', write the German authors of a history of penicillin in 1995.[93] 'They now set out to coordinate and promote the separate research efforts that were involved in trying to produce penicillin. To this end, a conference was held in Babelsberg on 2 October 1944, to be attended by all those concerned in positions of authority.'

Whether Westerdijk heeded Haagen's last request is not known, but it seems likely that she did. 'The number of requests for cultures has greatly increased, primarily as a result of the considerable interest in continental Europe in bacteria-inhibiting chemicals (mycoins such as penicillin, penatin etc.)', writes Westerdijk in the annual report on the activities of the CBS (*Verslag betreffende de werkzaamheden aan de Stichting Centraalbureau voor Schimmelcultures*) for 1944. 'The

[91] Westerdijk was not the only scientist who supplied fungi to the Germans. For the part played by the Germans in the research on penicillin, see e.g. W. Forth and D. Gericke, 'Von Menschen und Pilzen, Zur Entwicklung der Penicillinherstellung in Deutschland', *Deutsches Ärzteblatt* 92, 1995, no. 16, pp. 871-879. According to Shama, IG Farben had asked the CBS for *Penicillium* as early as 1942; see G. Shama and J. Reinarz, 'Allied intelligence reports on wartime German penicillin research and production', *Historical Studies in the Physical and Biological Sciences*, vol. 32, 2002, pp. 347-367, ref. p. 363.

[92] Archives of the Royal Society London, Howard Florey Papers, HF/1/3/1/22/5. With thanks to Dr Richard Coopey.

[93] W. Forth and D. Gericke, 'Von Menschen und Pilzen, Zur Entwicklung der Penicillinherstellung in Deutschland', *Deutsches Ärzteblatt* 92, 1995, no. 16, p. 874.

number of cultures from the genera *Penicillium* and *Aspergillus* numbered 910 and 389 respectively. Many industries in the Netherlands, Germany, Sweden, Switzerland and France have expressed an interest in the collection.'

Westerdijk was acquainted with the literature on penicillin, insofar as it was accessible. She sold *Penicillium* strains to Delft, Germany and many other European countries. Were these fungi of any significance to the German war effort, medically or in any other sense? If so, was Westerdijk guilty of selling materials to the Germans that were important to their war effort? If the fungi from the CBS had lost their power to produce penicillin, was Westerdijk aware of it?

These were the questions that the Utrecht Committee for the Restoration and Purification put to S.L. Schouten, called upon to deliver an expert opinion, on 12 September 1945.[94] 'We do not feel competent to make a judgement in this area', it stated.

Ten days earlier, the Committee had asked Westerdijk herself for an explanation. 'During our talks on 11 August', it wrote, 'you said that the position you adopted was not what you would have wished'.[95] 'Given the great national importance attached to the Central Bureau of Fungal Cultures, which was entrusted to your care, you said that you felt called upon to "guard against the loss" that threatened if the fungi were transferred to Germany. If you had tendered your resignation, or been taken prisoner your successor [van Beyma thoe Kingma] would have had no objection to moving the collection to Germany. You were therefore not free to determine your position.'

The Committee appreciated this line of argument, it wrote, but wished Westerdijk to exercise a certain degree of self-criticism: 'In what respect did your attitude leave much to be desired? What do you wish you had done otherwise?'

Westerdijk replied in considerable detail. Had she not been responsible for the CBS, she wrote, she would have chosen a different course of action, 'but that does not detract from my basic feeling.' Firstly, I would have joined one or more of the resistance groups in Amsterdam and Utrecht. But I did not want to attract any attention to myself, and I left Baarn only if it was absolutely essential to do so. I succeeded in ensuring that I was always there to receive any visiting Germans in person. If I had been absent, they would either have been received by the NSB man or by a female member of staff who would have

[94] Microbiologist, awarded his PhD under Went's supervision in 1901 (the title of his thesis being 'Reinculturen uit een onder het microscoop geïsoleerde cel' ('Pure cultures from a cell isolated under the microscope')).

[95] CHZRU, UU, 30 August 1945, UA, item 59 CC, UU, inv. 2884 'Zuivering Westerdijk'.

shown them the door. I wanted to maintain sole responsibility for determining the CBS's attitude.

Secondly, I would have protested openly in lectures against the dismissal of my Jewish colleagues. J. Smit of the College of Agriculture was immediately sacked after doing so; that is why I did not do it. Thirdly, without the CBS, I would have taken Jewish friends into hiding in Baarn. In the event, I compensated by providing these friends with all sorts of aid. Fourthly, I regret the lack of contact with former students. I did not dare to receive any groups, because of the presence of the NSB man; I did allow students to stay the night, when necessary. Finally, your committee commented on the fact that my presence at Senate meetings was scarcely demonstrative, if at all; but I do not possess a valid vote in the Senate. And in any case, 'in normal times too, my rule is "If you have nothing important to say, keep quiet.".'[96]

The CBS was indeed an institute of great international scientific importance. In 1940 it contained over 8,000 fungal strains.[97] For purposes of comparison: the largest collections in the United States and England, at that time, had no more than 300 to 400 specimens. It is true that Westerdijk had to make a considerable effort to preserve this collection during the occupation: not so much because of the threat of the collection's transfer to Germany – which, given the time at which this transfer was planned, would have been equivalent to destroying it – but because the specific requirements of each one of these fungi had to be met all those years. In the final weeks of the war, Westerdijk and her colleagues shared their food with the equally ravenous fungi.[98]

'It called for tact, skill and personal courage to keep this eminently desirable object out of the hands of the occupying forces', concurred the board of the CBS Foundation, on 10 September 1945, in a letter to the Committee for the Restoration and Purification of Utrecht University. 'Westerdijk did not take any action that was of any significance to the German war effort', wrote Schouten curtly in a letter of 15 September 1945, in response to a request for his advice.

On 20 September, the board of governors gave Westerdijk permission to resume her lectures. 'We shall inform you of our judgement concerning your behaviour, in the expectation that this frankness will help to dispel any grievances harboured against you', it wrote to Westerdijk. Its final judgement was as follows: 'Albeit that we can appreciate the factors that caused you to take up

96 Westerdijk to CHZRU, 7 September 1945, UA, item 59 CC, UU, inv. 2884 'Zuivering Westerdijk'.

97 When war broke out, a shadow collection of the CBS's fungi was rapidly put together at the Botanical Laboratory in Utrecht. How this collection weathered the wartime conditions, and what state it was in after May 1945, is unknown, however.

98 Westerdijk to Dr Karl Martin Silberschmidt, 12 April 1946, archives of the WCS.

the position you adopted, we nonetheless share your own feeling of regret that you did not display a spirit of resistance such as might have been possible, even in your circumstances.'

Given the Committee's double mandate, it is not surprising that it did not give more detailed grounds for its decision. Here as in other cases, the far more time-consuming 'purification' was at odds with the desire for a speedy 'restoration' of the university's work.[99] Even so, for a historical appraisal of the events, it would have been useful if the Committee had explained its decision at greater length.

Westerdijk dealt in fungi. But the CBS's fungi were sorted only according to their *morphological* properties – no research had been done on their *chemical* properties, let alone their *antibiotic* capacity, since Van Luyk's departure. 'We do not prepare Penicillin, or more in general Mycoine', Westerdijk had written to the director of the TNO on 15 February 1944. 'We are not properly equipped to do so, nor do we have the time for it.'[100]

She might just as well have added, 'and we simply can't do it'! If the Committee for the Restoration and Purification of Utrecht University had studied the production process of the medicine penicillin in a little more detail, its suspicions as to any active participation in the German war effort would have been dispelled immediately. Firstly, because it is a long way from a fungus to a medicine; the process starts in Petri dishes and leads to enormous fermentation tanks, then from animal experiments to the first experiments on human subjects; a long distance that could only be covered at an accelerated pace because the American government and industry were willing to invest vast sums of money and human resources in it. It is estimated that the United States invested $14 million in the project, as opposed to the Germans' $10,000,[101] and without any guarantee of success.

Secondly, because *Penicillium* is not exactly the ambrosia among fungi. Leave a loaf of bread on the window-sill for a week and you can pick the *Penicillia* off it; Koningsberger and Van Luijk in Utrecht simply harvested them from rotten apples.

Thirdly, because Westerdijk guaranteed only the morphological identity of her *Penicillia*. 'The reports in several papers are wrong', she wrote to the director of Amsterdam health service in August 1945. 'They say our *Penicillium notatum* is not working. One strain might work today and not tomorrow. Our

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99 See S. van Walsum, op. cit., p. 141.

100 Westerdijk to director of TNO, 15 February 1944, archives of the WCS.

101 G. Shama, 'Pilzkrieg: the German wartime quest for penicillin', *Microbiology Today* 30, 2003, pp. 120-123.

laboratory cannot be testing them all the time.'[102] She later replied in a similar vein to the Expert Committee on Antibiotics, newly established in 1950 as a subdivision of the World Health Organization, when asked if the CBS 'would be willing to serve as depository of official cultures for the production and testing of antibiotics, with the obligation of keeping these cultures in a satisfactory state (i.e. with regard to their antibiotic producing capacity and specific antibiotic-sensitivity respectively) and of making them generally available at the request of WHO'.[103] She wrote: 'our foundation contains a collection of fungus cultures, which are controlled for the morphological characteristics. We cannot, however, guarantee their chemical capacities, as no chemist is attached to our bureau and there is no question of appointing one, because of lack of funds. So we could only promise to keep cultures for your organization in a good morphological state, *but we could never be responsible for antibiotics or other particularities*.'[104]

Fourthly, because the correspondence regarding the supply of fungi to Germany took place at a time at which no scientist, however good, and no industry, however wealthy, would have been able to beat the Americans to the finishing post. In the autumn of 1944, the total collapse of the Third Reich was close at hand. Anyone who imagined that penicillin could be produced here was quite simply delusional.[105]

It remains to say a few words regarding Westerdijk's general attitude. 'It was impossible for Westerdijk, who had many ties of friendship with Germans, to sympathize with the total rejection of everything that was German', writes her friend Löhnis in a portrait of her mentor.[106] 'She was blamed for this later on.' Given Westerdijk's lifelong friendship with, most notably, the German plant pathologist Otto Appel, this seems plausible. After the liberation, the two resumed their old scientific correspondence about phytopathological problems, to their mutual satisfaction.[107]

Another source relates that her self-confidence was dented by the general condemnation of her friendship with Appel.[108] This too appears to be plausible. 'We know only too well that we have received bad publicity', she wrote to fellow biologist Frans Verdoorn in 1946.[109] 'But people are stirring things up

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[102] UA, item 59 CC, UU, inv. 2884 'Zuivering Westerdijk'.
[103] World Health Organization to Westerdijk, 27 June 1950, archives of the WCS.
[104] Westerdijk to World Health Organization, 22 August 1950, archives of the WCS [italics mine].
[105] See also; G. Shama, op cit., p. 367; Forth and Gericke, op.cit.
[106] M.P. Löhnis, *Johanna Westerdijk, een markante persoonlijkheid*, Wageningen, 1963, p. 60.
[107] Correspondence Westerdijk – Appel, 1948 and 1951, archives of the WCS.
[108] W. de Ridder and J. Teepe, *Leven en werken van Johanna Westerdijk*, Master's thesis, Biohistory Institute, UU 1980, in the context of the interview with the couple De Mooi-Bok, p. 40.
[109] Westerdijk to Verdoorn, 20 February 1946, archives of the WCS.

everywhere, we're used to it these days.' Her reaction to it was as down-to-earth as the pronouncement of a prewar family doctor confronted with a cold: 'It will have to run its course'.

6 'Toil and moil'

'The war stopped just at the frontier of Baarn', Westerdijk wrote in 1946 to one of her many foreign contacts in the world of phytopathology. 'One day longer, and the whole village would have disappeared.'[1] It is said that Westerdijk spent the entire evening playing the piano, completely alone, with the distant thunder of approaching bombing in the background.[2] The Villa suffered no damage.

The College of Agriculture was less fortunate. 'Many of the Wageningen institutes were severely attacked', she wrote to another fellow-phytopathologist. 'And the worst is, that all the instruments have been stolen by the Germans, not even brought to Germany, but sometimes thrown into ditches etc.'[3]

Who survived? How are they? And what state is science in, and phytopathology in particular? After five years of bitter isolation, the letters poured in. Former PhD student Alexander Liernur wrote from Goirle: 'We did not do too badly; were made to leave our home for three months and in February a V-1 landed about 100 yards away, destroying almost all the windows, the roof and the interior dividing walls. I also got a shower of glass in my face, which gave me an eye infection that lasted a month, but I'm happy to say that it's gone now.'[4] Otto Appel, from Berlin: 'In these past long years I have often thought of you and your splendid institute. … As a family, however, we came through these difficult years very well. In any case we are all still alive, and that is the main thing.'[5]

In answer to requests for information about various people, Westerdijk wrote back 'I can tell you that Dr Jordan died when he [was hiding from] the Germans, from heart disease. His wife is living. …. Honing is [well]; he married

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1 Westerdijk to Karl Martin Silberschmidt (Brazil), 12 April 1946, archives of the WCS.

2 W. de Ridder and J. Teepe, *Leven en werken van Johanna Westerdijk*, Master's thesis, Biohistory Institute, UU, 1980.

3 Westerdijk to Gerta von Ubisch (Brazil), 12 April 1946, archives of the WCS.

4 A. Liernur to Westerdijk, 17 September 1945, (defence of doctoral thesis, 4 July 1927), archives of the WCS.

5 Appel to Westerdijk, 9 April 1948, archives of the WCS.

again and has two small children, but his house at Wageningen was destroyed and his institute was badly damaged. … Miss Spierenburg is now over 65 and has left the phytopathological service [Plant Protection Service], but she is quite well, though her house at Wageningen has been totally destroyed by bombs. Dr Duifjes [was] murdered in a camp on Java, but I think his wife is living. Perhaps you remember Dr Diddens [of my staff]. She broke her neck by falling into a German traphole [roadside pit]. Pierette Bolle died in one of the dreadful Japanese camps in Java from hunger. … In Java many of my pupils have died or have been murdered and the ones that have come back already look very poor and thin, but we try to feed them up.'[6]

A few former members of staff came back to Baarn after the war, as if to revive memories of those innocent days of piano-playing, the Doctors' Wood, and Punch and Judy shows. One was Bea Schol-Schwarz, Westerdijk's first PhD student. After her marriage in 1926 she had moved to Batavia with her family, where she briefly worked as a teacher. After her husband's death in a Japanese camp, she returned to Baarn and accepted a post as a mycologist at the Central Bureau of Fungal Cultures (CBS). For many years, she and Westerdijk, both by then advanced in years, dined together once a week at Villa Java. Alide Van Hall-de Jonge, the widow of Ritzema Bos's first assistant, also paid regular visits after returning from Suriname, as did Went's widow, Catharina Jacomina Went-Tonkens.

But the ladies had little time for small talk. 'I must tell you that for the past few months the Central Bureau's workload has been three or four times what it used to be,' Westerdijk wrote to fellow biologist Verdoorn in the United States. 'At first I assumed that it was an initial reaction after the war, but the penicillin research has boosted interest in all mycology activity, and this is unlikely to change in the foreseeable future. … the work keeps coming in … On top of this, staff with a solid grounding in mycology are impossible to find … Everyone here has far too much to do. … We have so many plans, but we count ourselves lucky if the most essential work gets finished; much of it is still waiting to be done.'[7]

Every minute of Westerdijk's time was accounted for. Though now gaunt, she was still bursting with energy. Aside from the usual specimens and requests for advice, letters were now arriving from all over the world asking for publications and fungus strains. Literature from the English-speaking countries,

6 Compilation of correspondence 1945-1948, archives of the WCS; former students who died during the Japanese occupation included V.C. van Gennep (PhD 1936), and J.P. Karthaus (PhD 1927). J.J.A. Hellinga (PhD 1941) was run over by a Canadian motor vehicle shortly after the liberation.

7 Westerdijk to Verdoorn, 28 October 1946, archives of the WCS.

which had not been received for several years, was now piling up in the library. Westerdijk made several trips to Zürich to resume contact with old acquaintances. Former students from the Dutch East Indies, including Dorus van Eek, Betje Polak and Hans ten Houten, asked her to mediate in finding them jobs. Four PhD students were working on theses. But Westerdijk had great difficulty finding people to help with the research at the Phytopathology Laboratory. 'There is no one with a master's degree, and those who are studying for one understandably want to finish as soon as possible, now the war is over', she wrote in her first postwar annual report. Another big problem, she said, was getting people adequate salaries.

Not until the appointment in 1949 of Dr Dolf von Arx, a 27-year-old Swiss scientist – 'since Dutch assistants were impossible to find' –[8] was the pressure relieved. 'He is a highly trained mycologist, who will be of great assistance in identifications and has very sound methods of phytopathology', she wrote in the annual report.[9]

The Phytopathology Laboratory gradually returned to full strength. By 1951 it had built up a certain routine. Von Arx, as 'first assistant', was in charge of students' lab work; Gé van den Ende ('second assistant') was responsible for the work on poplar canker; and Wim Graafland ('third assistant') helped out wherever necessary. Johanna Went was still studying elm disease, and Dr Willem Feekes (who had gained his PhD under Westerdijk's supervision in 1931) was paid from 1948 onwards by the chemical factory Vondelingenplaat to research the effectiveness of certain fungicides. A secretary, a library assistant, the gardener Van Veenendaal and the odd-jobs-man Jan Kiljan, appointed in 1930, took care of all the necessary chores.

The board had also resumed its regular meetings. Its composition had remained the same for years: it was still dominated by the botany professors of the universities of Utrecht and Amsterdam, a treasurer, and Westerdijk herself, in the capacity of secretary. Every year they would pore over the annual report, the budget, internal changes, accounts and accountability, and the state of the funds. Interim meetings were rarely needed.

'The plan is now to get one or more young people onto the board', wrote Westerdijk in 1950, 'and like the other members I was keen on the idea of bringing in a colleague from Wageningen. In this small country, where people can keep in regular contact, more opportunities … should be created for consultations on phytopathological issues.'[10] With the advent of the Wageningen

[8] Minutes of the 77th board meeting, 20 March 1951, archives of the WCS. Von Arx was a student of the Swiss professor of mycology and phytopathology, Ernst Gäumann.

[9] WJPLWCS for 1949.

[10] Westerdijk to A.J.P. Oort, 11 May 1950, archives of the WCS, 'secretariaat 1943'.

professor Jo Oort on the board of the Foundation – 'I hope that as a 'youthful' member, I shall show myself worthy of my place on the board', Oort replied straight away[11] – a personal link was forged between the phytopathology teams in Wageningen and Baarn for the first time since Ritzema Bos's departure from the Laboratory.

This innovation was Westerdijk's last action as secretary of the board. In March 1952 she announced her intention to resign as director of the Willie Commelin Scholten Phytopathology Laboratory on 15 October. 'I have felt compelled to make this decision, since I wish henceforth to devote my energies entirely to the Central Bureau of Fungal Cultures, which urgently requires my full attention', she explained.[12]

She was 69 years of age. Ernst Krelage, who was in his eighties, decided this was an opportune moment for him to step down too. 'For 57 years, ever since the Foundation was established in 1894, I have shared uninterruptedly in all its fortunes', wrote the one-time university friend of Willie Scholten. 'I now find, however, that the advancing years make it difficult for me to attend meetings, and I therefore believe that the time has come, partly since the era presided over by Professor Westerdijk is drawing to a close, for me to lay down my position on the board when she retires.'[13]

One more time, the specially hired reception hall in Hilversum filled with guests. One more time, Westerdijk, dressed in full academic robes, climbed onto the platform and addressed the audience from the lectern. Radiant, she talked about her parents, her university days, Hugo de Vries, Ritzema Bos, her first few years as director, the move to Baarn, Van Luyk, the lectures, Went, the penicillin, her female students, the Central Bureau of Fungal Cultures (which had grown 'like a weed'), the 'idyll' of the houses Java and Madoera, the for-fine-minds-the-art-is-to-mix-work-and-parties era, the modern education that had grown to such impressive proportions.

'And now', she said, coming to the end of her last public lecture, 'I have to say the sentence I have never said before: my time is up. This chapter of phytopathology is finished. I should like to thank all of you, for making this farewell ceremony such a gratifyingly *festive* event.'[14]

[11] Oort to Westerdijk, 15 May 1950, archives of the WCS.

[12] Westerdijk to board, 26 March 1952, archives of the WCS.

[13] Krelage to board, 25 March 1952, archives of the WCS.

[14] J. Westerdijk, *Afscheidsrede aan de universiteiten van Utrecht en Amsterdam*, Hilversum, 22 November 1952. That same day the Johanna Westerdijk Fund was set up, to support phytopathological and mycological work in the broadest sense.

Westerdijk and Ten Houten at Westerdijk's farewell celebrations, 1952. Archives of the WCS, Haarlem.

Westerdijk continued to live at the Villa. She received numerous tributes and distinctions. She was made a knight of the Order of the Netherlands Lion, a knight of the Order of Santiago da Espada and a member of the Royal Netherlands Academy of Arts and Sciences; she also received the Otto Appel medal and honorary doctorates from the University of Uppsala and the Justus Liebig University in Giessen.

'The last few years of her life were a great strain', her friend Löhnis would write: 'Her sight declined badly and she found it difficult to get about. On 15 November 1961 she died in her apartment at the Willie Commelin Scholten Laboratory. Hundreds of friends came to the funeral at Westerveld, where she was buried under a profusion of brightly-coloured flowers.'[15]

Science of dynamic equilibrium

The board did not spend much time debating the matter of Westerdijk's succession. Koningsberger and his counterpart at the University of Amsterdam,

[15] M.P. Löhnis, *Johanna Westerdijk, een markante persoonlijkheid*, Wageningen, 1963, p. 72.

Professor Adriaan van Herk, in consultation with Westerdijk, simply nominated two candidates. Their first choice was Dr Louise Kerling, a researcher at the College of Agriculture in Wageningen, while the reserve candidate was Dr Heinrich van Vloten, director of the Forestry Research Institute in Wageningen. The minutes of the 78th board meeting rather unnecessarily pointed out that the board's preference was for the first candidate, but that since the municipality of Amsterdam had insisted on two nominations, they had added another one.

Louise Kerling was in almost every respect Westerdijk's opposite. She was petite, modest, and had the refined manners that typified the East Indies circle in The Hague. Her career had followed an arduous path with numerous stops and starts. She had gained her master's degree in the fashionable city of Leiden, but had then transferred to Utrecht University, gaining her doctorate under Westerdijk's supervision at 28 years of age.[16] Westerdijk liked 'rebellious' moves of that kind, she said in her farewell address – but unlike some former students, Kerling had never become a frequent visitor at Baarn.[17]

In her university days, she spent her summer holidays working at the Plant Protection Service in Wageningen, and met Dina Spierenburg among others. She also spent a summer at the Laboratory for Mycology and Potato Research in Wageningen, under the supervision of Professor Hendrik Quanjer.

After her master's examinations in 1925, she was in danger of falling prey, like so many biologists, to the 'wretched' fate of unemployment.[18] The only available job was taking care of the rats at the Plant Protection Service, but through the mediation of Professor Eildert Reinders, professor of botany there, she was able to get a job at the botany department in Wageningen. She developed expertise on anatomical and morphological matters (including the subject of her dissertation under Westerdijk) and in 1929, after gaining her PhD, she left for Java, where she became a teacher at the colonial government's General Secondary School in Yogyakarta. She was very disappointed to find that there were no vacancies at the Ministry of Agriculture or at any of the research stations there.[19] Kerling taught at a number of secondary schools in Indonesia until 1942, and tried to carry on with her academic work in her free time. During the Japanese occupation she briefly worked at the General

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[16] L.C.P. Kerling, *De anatomische bouw van bladvlekken*, PhD thesis Utrecht, 1928.

[17] J. Westerdijk, *Afscheidsrede aan de universiteiten van Utrecht en Amsterdam*, Hilversum, 22 November 1952, p. 5.

[18] Ibid., p. 9.

[19] Even if any such jobs had been available, she would have had little chance of getting one. 'The Ministry of Agriculture was exceedingly hostile to women', recalls F. Quak, a former member of staff at the Institute of Phytopathological Research in Wageningen. Interview, 7 March 2005.

Agriculture Research Station in Buitenzorg (Bogor), but within twelve months the occupying forces had interned her in the camp Halmaheira in Semarang.

After the camp was liberated, she was too weak and ill to travel. She spent a few months in hospital, and then went to Australia to convalesce. Once she had regained her strength, she started studying phytopathological problems there, at Waite Agricultural Research Institute in Adelaide. It was then that Quanjer wrote to her from the Netherlands, inviting her to join the staff of the Laboratory for Mycology and Potato Research, where she subsequently supervised lab work and conducted research into viruses for six years. At 52 years of age, she was finally appointed director of the Willie Commelin Scholten Phytopathology Laboratory,[20] along with a double appointment as extraordinary professor of phytopathology at the universities of Utrecht and Amsterdam.

'She was a sweet person', recalls Jan Carel Zadoks, professor emeritus of phytopathology at Wageningen Agricultural University. 'Utterly serene, and although emotionally scarred by her past, she never complained about it for a minute. She took care of her old mother, who was extremely nasty to her, but she did not complain about that either. But her face would light up when she had been to stay with her younger sister in London and had been "to the playhouse".'

In photographs she appears a slight figure, bag firmly clasped under her arm, silvery-grey hair immaculately coiffed, an elegant coat reaching down to her calves, simple flat shoes. 'Her character and posture exuded modesty', says Zadoks. 'A real lady. She personified the "harmony model", a term that did not yet exist at this time. She had to manoeuvre her way through a minefield of relationships: Foundation vis-à-vis universities, Baarn versus Wageningen, fundamental versus applied science. She was used to fighting – and despite her modesty, she knew exactly what she wanted. Scientifically, it was a period of building up and exploring new areas; it was an arduous, endless and unspectacular period of toil and moil.'

Others recalled her fine qualities as a teacher, and her dedication and commitment to PhD students. 'I remember a long period during which we met every Sunday morning and hammered out all sorts of subjects', wrote Bob Schippers. 'Apparently, Westerdijk was fond of heated debates, which sometimes made Kerling uncomfortable.'

Schippers continues: 'Kerling continued the tradition of marking each PhD with parties, held partly in the Madoera hall and partly outside in the large,

[20] Derived from A.J.P. Oort and J.G. ten Houten, 'Professor Kerling, her life and work', *Netherlands Journal of Plant Pathology* 76, 1970, pp. 110-118.

Louise Kerling, c. 1969. Reproduced by courtesy of Nyckle Fokkema.

romantic garden. She turned up to one of these events dressed up as the historical 'Lady Commelina' and put on a fantastic act to go with it. … I greatly admired the way she shaped phytopathology at Baarn.'

By this time, phytopathology had grown into a wide-ranging area of science, with budding subspecialisms and branches to other disciplines. New themes and cooperative frameworks took shape at the major international conferences, where dozens of phytopathologists from all over the world met and exchanged ideas.

But the heart of the field was unchanged, said Kerling in her first public lecture at Utrecht University. '"Disease" is not a "state", a structural deviation', she said, 'but a chain of processes involved in the changing interaction between the plant and its enemy; in other words, "disease" is a dynamic event. The eventual syndrome arises only if and when many factors coincide at the right moment in the interaction between plant and pathogen.'[21]

Not every plant becomes diseased if it encounters a potentially harmful parasite. Plants seem so immobile, so vulnerable to all those parasites that are always beleaguering them. The simple potato has 300 potential enemies; if infection were always to lead to disease, there would not be a single potato left. So how do so many potatoes survive?

The complexity of the problem had become increasingly clear over the past fifty years. 'There are still many diseases, such as those of little-studied weeds, of which we have only a single image: a split second in the entire "film" that would show the course of the disease process. Recording this film from the very beginnings of the encounter is not easy.'[22]

Some pathogens are so virulent that little is needed to trigger the disease. In other cases, the disease may develop after inoculation, or it may not. 'These are the "difficult cases", remarked Kerling, 'involving a shifting equilibrium.'[23] Take the capricious picture presented by soil parasites, for instance. 'Frequently, two or more organisms, each one harmless in itself, may together make the host plant's life impossible. More and more examples are known of nematodes making innocuous gashes in the root bark, which may then be penetrated by non-aggressive fungi; root rot may develop as a result.'[24] Then there is the influence of the host plant's age. The aging of a host plant brings with it certain

[21] L.C.P. Kerling, *De phytopathologie, wetenschap van het dynamisch evenwicht*, inaugural address upon accepting the position of extraordinary professor of phytopathology at Utrecht University ('Rede uitgesproken bij de aanvaarding van het ambt van buitengewoon hoogleraar in de phytopathologie aan de Rijks-Universiteit te Utrecht'), 26 January 1953, p. 8.

[22] Ibid., p. 7.

[23] Ibid., p. 8.

[24] Ibid., p. 8.

changes, as a result of which it may become more – or less – sensitive to certain parasites. Weather conditions must also be taken into account: temperature, light, moisture in air and soil, a crop's density – each factor plays a role in the process and in turn influences the influence of others.

A fundamental question, said Kerling, was: 'Does the metabolism of tissue change only *after* the penetration of the pathogen, or do deviations occur before then? In other words, is the damage a secondary effect after all? Up to now, most studies have been conducted on plants that are already diseased, so it is hardly surprising that deviations are found in physiological processes, such as an increase in temperature and respiration, changes in transpiration, in redox potential, and constant changes in permeability. What is far harder is finding out whether such changes, induced by environmental factors, may make the plant vulnerable prior to infection. For it is perfectly clear when a plant has been infected, but conducting research at the precise moment at which a pathogen could penetrate the plant is not so easy.'[25]

Plants are constantly reacting to their surroundings – their state may be conducive to their enemies at some times, and not at others. Acquiring a clear picture of the metabolism of diseased and healthy cells, of the dynamics of life processes, and of the interaction between a plant and its enemies, is crucial to a proper understanding of the disease process, and will help in the quest for practical methods of disease control. 'But the reactions that determine the relationship between plant and pathogen are in constant flux; the situation is never identical at two different moments in time. Sayings like "Nothing is unchangeable except change itself" and a more modern one from Alfred North Whitehead: "Nature is a structure of evolving processes" are certainly confirmed by phytopathology. I [hope] that the growing knowledge of this dynamic series of events will bring us one step closer to understanding the driving force, inextricably bound up with these chains of physical-chemical processes, that is called "Life.".'[26]

Less than two months before, Westerdijk had given her farewell lecture. In a 1984 memoir of her one-time supervising professor, Kerling wrote: 'One of her former students noted that he had never heard her [Westerdijk] use the word *mysterious*. Is it not mysterious that a fungus, such a delicate little thread, can penetrate the hard surface of a plant? 'No', she would say, 'you simply solve the mystery by studying it. Once you know how it works, there is no longer any mystery.'"[27] This retort is typical of Westerdijk's gruff, non-metaphysical

[25] Ibid., p. 11.
[26] Ibid., p. 14.
[27] L.C.P. Kerling, 'Ter herdenking: Johanna Westerdijk als pionier in de fytopathologie', *Vakblad voor Biologen* 64, 1984, pp. 86-87.

approach to matters of science and life in general. So it made a sharp contrast when her frail successor opened her inaugural address with a biblical verse, Ecclesiastes 7:24:

That which is, is far off and
exceeding deep; who can find it out?

The demands of education and research

'In the matter of the succession, the following difficulty arises: originally a private Foundation, the WCS has grown into a Laboratory that two universities use intensively for the benefit of biologists wanting to choose phytopathology as a subsidiary subject', the board had already noted before.[28] 'Everyone agrees that nothing would be worse than losing the connection with these two universities, since it would jeopardize the very survival of the Foundation's work'.[29] But how much should the universities be paying for their use of the facility?

Westerdijk tended to downplay the matter of costs. In 1948, for example, when the chemical factory Vondelingenplaat had enquired on what conditions the Foundation would be willing to make some laboratory space available to Dr Willem Feekes, who wanted to do some research for the factory, and she suggested a possible charge, the board member Kruyt was appalled: 'Far too little,' he said immediately:[30] 'to begin with, we should emphasize the high quality of all the facilities, given the wide range of instruments, library, assistance and the presence of the Central Bureau of Fungal Cultures, and what is more the atmosphere of the Laboratory as a whole, and explain that all these benefits come at a substantial price. After all, the factory would be saved the expense of having to build an entirely new laboratory!'

And truth be told, added the chairman of the board, Koningsberger, when this point came up for discussion again at the time of Westerdijk's resignation, it was not right that the Foundation should have been forced for years to supplement the salaries of Dr Von Arx and the director. Only the costs of 'real fundamental research' should be borne by the Foundation; everything intended solely for teaching should be paid by the universities, including the various fuels and a proportion of the gas, water and electricity bills.[31] 'In many cases these costs are difficult to split up, but in any case it is clear that the payments made by the universities are far too low in proportion to our total expenditure.'

[28] Minutes of the 78th board meeting, 29 March 1952, archives of the WCS.
[29] Minutes of the 76th board meeting, 1 April 1950, archives of the WCS.
[30] Minutes of the 74th board meeting, 20 March 1948, archives of the WCS.
[31] Minutes of the 78th board meeting, 29 March 1952, archives of the WCS.

Everything needed for *education* should be paid by the universities, while *research* costs should be borne by the Foundation. But the representative of the University of Amsterdam took a different view, in 1953: 'Research is certainly part of universities' educational remit'. The Foundation should pay only for research that did not come within the scope of higher education, he concluded generously.[32]

Furthermore – and here all heads started nodding vigorously – the Laboratory no longer came near to fulfilling all the requirements of modern science. It was far too small, to start with. Staff and student numbers were increasing so fast that there was a constant shortage of workspace. Besides this, the building was antiquated. Paint was peeling off the walls, the rooms were dark and inefficiently equipped, and the roof of the Madoera house was in danger of collapse. And most importantly: good phytopathological research – and that was certainly what students were expected to familiarize themselves with – could no longer rely on grafting needles and microscopes. For virological projects, the Laboratory needed a new glasshouse, complete with heating and with cooling apparatus. 'Experimental research makes very heavy demands', agreed Kerling.[33]

After months of consultations with the universities, the Government Architect, the municipalities of Baarn and Amsterdam, the director of the CBS, and the building contractors, renovation work started in 1955. The Foundation paid for the entire operation, while the universities signed a rental contract 'including the right to share the whole laboratory.'[34] A separate arrangement had been made with Utrecht University: it purchased a plot in the garden for one guilder and financed the building of a virus greenhouse on it.

The demolition, building and conversion work went on for years, crowned on 9 July 1957 by the festive opening of the renovated Villa and the new greenhouse, with 180 guests. 'The air-conditioned greenhouse was a much-frequented refuge on that day, with the outside air temperature reaching 35°C – proving that the cooling apparatus works well', stated the annual report. The director received a lamp for her room from the board and an electric clock for the upper corridor from the personnel. There was a separate party organized by and for the personnel: an afternoon with games in a meadow near Kievitsdal, followed by a banquet. 'That day was a well-deserved reward after a period dominated by dust and disruption, and the inevitable extra work while the Laboratory was being renovated and the equipment installed', said Kerling.[35]

32 Minutes of the 80th board meeting, 21 March 1953, archives of the WCS.

33 WJPLWCS for 1955.

34 WJPLWCS for 1953.

35 WJPLWCS for 1957.

Building of new glasshouses, c. 1958. Archives of the WCS, Haarlem

'The new wing of the old building, partly on the hill [where old oaks had been chopped down to make room for this wing], now provides us with the space we have desired for so long, with its twenty rooms measuring two, four or six metres in width, each one with a different interior tailored to its purpose and painted in light colours', wrote Kerling. 'Modern construction technology makes it possible to create a purpose-built laboratory with wide windows, fixed tables and cupboards. In spite of the high-ceilinged stairwell that divides the new laboratory from the old one, the difference in building style between the two sections is conspicuous, perhaps even glaring, which many think is a pity. But there was no alternative; continuing to build in the style of 1839 could never lead to the goal – a modern laboratory. … Now that it's all over and everything is in its place, we finally realize what a paradise of light and space we are now able to work in, accustomed as we were to so many dark old rooms.'[36]

And there was another piece of news. 'In 1957 the series *Mededelingen van het Phytopathologisch Laboratorium "Willie Commelin Scholten"* ['Communications from the Willie Commelin Scholten Phytopathology Laboratory'] will be resumed,' said Kerling, 'with offprints from different journals to be published in a cover with the Foundation's issue number and initials. This will mean that after a 19-year lapse, the 14th issue of the *Mededelingen* will be followed by the 15th.'[37]

Issue 15 of the *Mededelingen van het Phytopathologisch Laboratorium* in fact displays the complete spectrum of all the research that the Laboratory's team had been working on for the past several years. Dr Dolf von Arx emerges as a fully-fledged exponent of Westerdijk's specialism, with research on the species differentiation between different fungi, more specifically a number of *Colletotrichum* species.[38] The female student A. Timmermans, who had conducted a brief piece of research on damage to Rhodendron leaves inflicted by *Chaetapiospora rhododendri* (Tengw.) v.Arx, under Von Arx's supervision, reported in this volume that the inoculations were successful only after the leaves had been damaged, leading to the conclusion that the fungus used was a wound parasite.[39]

[36] L.C.P. Kerling, 'De stichting het Phytopathologisch Laboratorium Willie Commelin Scholten', *Tijdschrift over Plantenziekten* 63, 1957, pp. 161-168.
[37] Ibid., p. 165.
[38] J.A. von Arx, 'Kultur- und infektionsversuche mit einigen *Colletotrichum*-arten', *Tijdschrift over Plantenziekten* 63, 1957, pp. 171-188 (*MPLWCS* no. 15).
[39] A.Timmermans, 'Aantasting van bladeren van Rhododendron door *Chaetapiospora rhododendri* (Tengw.) v. Arx', *Tijdschrift over Plantenziekten* 63, 1957, pp. 191-192 (*MPLWCS* no. 15).

Hans Heybroek, who had taken over the research on elm disease after Johanna Went's departure in 1952, reported, together with M.A.A. Schipper, that the virulence of various *Nectria* strains (generally innocent saprophytes on dead timber, but occurring suddenly as parasites on the Christine Buisman elm) could be efficiently tested on externally disinfected twigs of maplewood.[40] Wim Graafland, who had been appointed by Utrecht University in 1953, reported, partly on behalf of student assistants Theo Gadella and Hendrien Brants, on a method of cultivating tomato roots infected with tobacco mosaic virus.[41] Finally, Gé van den Ende, who had taken over the research on poplar canker after Greet Brink had left to get married in 1949, published the findings, together with Koen Verhoeff (who was by then working at the Glasshouse Fruit and Vegetable Crops Research Station in Naaldwijk) of the research on the influence of copper compounds on the development of several specific fungi *in vitro*.[42]

With these *Communications*, the revamped laboratory presented its new face to fellow phytopathologists in the outside world. The only difference with the *Mededelingen* of twenty years before was that these articles had also been published in – and hence assessed in advance by – the *Tijdschrift over Plantenziekten*, the Dutch journal of phytopathology.

Retrospectively, though, the most striking feature of these new *Communications* was not that they clearly met modern standards of scientific excellence, but that almost all the ingredients for the research with which the Phytopathology Laboratory would distinguish itself under Kerling's directorship were already present.

Fundamental research

'There used to be a garden outside the laboratory', grumbled the gardener, Van Veenendaal.[43] 'Now it looks like a factory. The garden is full of greenhouses.'

Unavoidable, said Kerling. Good research could only be done in air-conditioned chambers or cabinets, where experiments could be set up and carried out on a smaller scale. That made them expensive, but research always cost a lot of money, the board members agreed. 'A firm that wants some work done

[40] M.A.A. Schipper and H.M. Heybroek, 'Het toetsen van stammen van *Nectria cinnabarina* (Tode) Fr. op levende takken in vitro', *Tijdschrift over Plantenziekten* 63, 1957, pp. 192-194 (*MPLWCS* no. 15).
[41] W. Graafland, T.W.J. Gadella and D.H. Brants, 'Het kweken van tomatewortels besmet met tabaksmozaiekvirus', *Tijdschrift over Plantenziekten* 63, 1957, pp. 195-197 (*MPLWCS* no. 15).
[42] G. van den Ende and K. Verhoeff, 'De invloed van koperverbindingen op de ontwikkeling van enkele schimmels *in vitro*', *Tijdschrift over Plantenziekten* 63, 1957, pp. 200-208 (*MPLWCS* no. 15).
[43] Interview of De Ridder and Teepe with Van Veenendaal, 9 January 1979, transcript in Utrecht University Museum.

has no choice but to have it done at the WCS, unless it builds a laboratory of its own.'[44]

On the other hand: advancing specialization meant that choices had to be made. Newer avenues in phytopathology could only be pursued if money was constantly being invested in the rapidly developing spheres of modern apparatus and technology. In 1960 Kerling was already conceding that the Phytopathology Laboratory was in danger of falling behind, in spite of the upgrading of its apparatus and its new virus greenhouse. 'Many students are eager to work with the latest equipment and to conduct research at the forefront of science in areas they have heard about in lectures,' she wrote in the annual report. 'However much this may testify to youthful ardour, and perhaps to inflated egos, many are deterred from taking their Master's degree in phytopathology, since Baarn is continuing to work along "classical" lines.'[45]

If that was the case, said board member Professor Van Herk (University of Amsterdam), these modern aids must be purchased –'the sooner the better'.[46] 'All costs related to teaching and research done by the professor of phytopathology should be borne by the universities'[47]; that had been agreed explicitly. *All* costs: that is, including the costs of the library, the rewiring of the upstairs floor, the new Venetian blinds, the new tables in the house Madoera, the chemicals cupboard in the main hall – and if students wanted to work with radioactive isotopes, the universities would have to pay for that too.[48]

On the other hand, innovation was not needed in every single working area. For instance, the specimens sent in for analysis could still be dealt with perfectly well using the existing apparatus. They were also of educational value, since they were useful in teaching students how to conduct research responsibly and scientifically. The older research lines (on elm disease and poplar canker) had also relied on the same standard procedures for decades and could be continued using simple resources.

It was *fundamental* research that was in danger of falling behind. And fundamental research was precisely the area in which the Phytopathology Laboratory should increasingly be distinguishing itself, said Kerling. Not only new members of staff, but also those who had been working on a single research line for years, should do their utmost to advance their research and continually to test the limits of the unknown. The Phytopathology Laboratory was no longer the place to do routine work or standard tests; it should be an institute

44 Minutes of the board meeting of 21 March 1953, archives of the WCS.
45 WJPLWCS for 1960, p. 7.
46 Minutes of the board meeting of 19 April 1961, archives of the WCS.
47 Minutes of the board meeting of 29 April 1960, archives of the WCS.
48 Minutes of the board meeting of 19 April 1961, archives of the WCS.

for new, free, in-depth, challenging projects – 'curiosity-driven frontline research'.[49]

Lack of space soon reared its head again. As long as Westerdijk and the Central Bureau of Fungal Cultures had stayed at the Villa, the much-desired expansion was out of the question. But even if the six rooms used by Westerdijk and her housekeeper were to become available, it would still be necessary to expand in the short term,[50] since the fungus collection kept growing, and with the constant flow of guests, the old building was soon bursting at the seams again. Would it not be better to make the Baarn laboratory into an inter-university institute, attached jointly to the universities of Amsterdam and Utrecht, and possibly also to those of Leiden, Groningen, and Nijmegen and the Free University?[51]

The new wave of renovations began immediately after Westerdijk's death and her housekeeper's departure. This was also the starting signal for negotiations with the executive committee of the CBS, presided over since 1958 by Atie van Beverwijk, and the Royal Netherlands Academy of Arts and Sciences, under whose auspices the CBS had operated officially since 1934. The spirit of 'reconstruction' was now taken more literally. A new invasion followed of concrete mixers, scaffolding and construction workers. Once again, the site was covered in dust, sand and rubble.

Three years later, the ten mycologists, the technicians, the secretary, director Von Arx (appointed in 1963 after the sudden death of Van Beverwijk), part of the library, the kitchen apparatus as well as the CBS's fungus collection all moved to brand-new premises at a stone's throw from the old Villa. The separation was formally completed in 1967; from then on, the two institutes went their own way – linked only by a glass corridor, which the CBS closed off scrupulously every evening.

The Phytopathology Laboratory remained a private institution; in 1964 the Free University too starting using it – and helping to fund it. In 1965 the Laboratory had 23 permanent employees, all of them appointed and paid by one of the three universities.[52] A separate lab had been equipped to do research with isotopes, and the rooms freed up by the CBS's departure had been

49 L.C.P. Kerling, *De phytopathologie, wetenschap van het dynamisch evenwicht II*, inaugural address upon accepting the position of extraordinary professor of phytopathology at the University of Amsterdam ('Rede uitgesproken bij de aanvaarding van het ambt van buitengewoon hoogleraar in de phytopathologie aan de Universiteit van Amsterdam'), 20 April 1953.

50 WJPLWCS for 1960.

51 Minutes of the board meeting of 19 April 1961, archives of the WCS.

52 Eight were paid by the University of Amsterdam, thirteen by Utrecht University, and two by the Free University.

converted into laboratories for physiology and virology. In the summer of 1967, there were almost fifty people working at the Laboratory. Even so, Kerling wrote in her annual report, it had been a remarkably quiet period, 'now that, with the advent of a good internal telephone [paid for jointly by the three universities] much walking about the corridors had become unnecessary.'

At the end of the 1950s, the research was roughly divided up according to pathogen: Von Arx, together with his assistants and students, represented systematic mycology (fungi), while Wim Graafland, after the installation of the virus greenhouse, specialized in virus research, and Ton de Lange focused on bacterial diseases. In the 1960s the focus shifted to new themes, primarily defined in phytopathological terms.

'The "diseased plant" is at the heart of the research conducted over the past few years', Kerling wrote proudly in the mid-1960s.[53] 'Studies focus on the mutual influence of plant and pathogen. In particular, attention is devoted to what goes on in the 'phyllosphere', the space bordering on the leaf surface, and processes that take place in the 'rhizosphere' under the influence of exudates from the plant, of toxic materials formed by the pathogen, and of ever-present saprophytic microorganisms. This applies both to pathogenic fungi and to viruses. In addition, research is conducted on the transport of viruses by plants and on the nature of vascular parasitism, concentrating especially on the pathogen causing elm disease.' On average, there were twenty students in the Laboratory studying a subject for their master's thesis, each of whom stayed for about six months. Depending on their interest and abilities, they could specialize in one of the four research lines that were central to the Laboratory's work from this time onwards.

PHYLLOSPHERE

The phyllosphere, as a research field, though not actually discovered in Baarn,[54] was introduced and developed there at lightning speed. This new concept had made its entrance in 1955; and as early as 1956, in the annual report, Kerling noted that Von Arx had already conducted a short research project on it. In 1958 she published her first full-length article on what had been discovered about life in this small, intriguing space.[55]

[53] WJPLWCS for 1965.
[54] The term had previously been used by J. Ruinen, 'Occurrence of *Beijerinckia* species in the "Phyllosphere"', *Nature*, 1956, pp. 220-221; F.T. Last, 'Seasonal incidence of *Sporobolomyces* on cereal leaves', *Transactions of the British Mycological Society*, 1955, pp. 453-464.
[55] L.C.P. Kerling, 'De microflora op het blad van *Beta vulgaris* L.', *Tijdschrift over Plantenziekten* 64, 1958, pp. 402-410 (*MPLWCS* no. 23); students had cooperated on this research project.

For ongoing research on the parasitism of *Phoma betae*, she wrote, the mangold had been selected as the research object. From a field where this crop was under cultivation in Uden, far from any residential area and surrounded by fields planted with cabbage, turnips and more mangold, the researchers had collected the outer leaves of some of the plants in the middle of the field, on 21 May, 11 June, 2 and 24 July, 18 August, 8 September and 6 October 1957, and had taken them to Baarn, wrapped in plastic bags. There they calculated the surface area of the leaves and rinsed them for two hours with a known quantity of sterile water. They then placed three drops, also of known volume, of 1:2 or 1:4 diluted rinsing water on a culture medium in a Petri dish. All that remained was to wait and see what would grow there.

The colonies of fungi, yeasts and bacteria that developed in the Petri dishes were counted, and the fungi grown in pure culture and identified, along with some of the most common yeast species. They also gave the fungi that had not been carried along with the rinsing water an opportunity to develop by spreading out small pieces of leaf on agar. And finally, they extrapolated the counts, so that they could ultimately calculate the total number of organisms living on each square centimetre of the leaf. They incorporated the results into a graph.

The graph showed clearly that the number of yeasts was very large on 21 May but very low again on 11 June. The prolonged rainfall, immediately before picking time, had probably rinsed the leaves clean. In July the number of bacteria and yeasts had risen again, and in August the number of organisms increased further, 'probably under the influence of the increasing relative moisture and the still fairly high average temperature'. September's crop was meagre, however, probably because of rain. In October the number rose again.

For purposes of comparison, Kerling and her assistants had also picked some mangold leaves from the laboratory garden on 2 November 1956: one a mature green, one yellowing, and one withered. Their analysis of these leaves showed that the quantity of organisms increased with the age of the leaf. In total they succeeded in isolating 721 fungal colonies belonging to about 34 species from these leaves. *Phoma betae*, a well-known parasite of mangold, was one of them. To study the relationship between this fungus and the mangold leaf, the team inoculated healthy mangold leaves in July (average temperature about 20°C), in August (maximum temperature 17°C) and in September (11° to 13°C) with a spore suspension of *Phoma betae*. The typical symptoms of disease manifested themselves less and less, and with an increasing delay: but 'it is unclear whether this was caused by the gradual decrease in temperature or the aging of the leaf.'

So what did this research show about the microflora on the mangold leaf? 'As expected,' wrote Kerling, 'the flora on the mangold leaf are greatly influenced by the conditions.' With the aging of the leaf, and the increase in atmospheric humidity and temperature, the number of organisms also increased. Most of the organisms isolated were known as saprophytes, which came from the air or from splashing soil and ended up on the leaf. 'They are ubiquists, which feel at home on a wide variety of substrates and which can also feed on the exudate from the mangold leaf.' Whether there was any specific affinity between these organisms and the leaf could not be established until the results had been compared with the flora from other mangold leaves, or with the flora from other plants in the surrounding area.[56] But it was now clear that 'in the space closely bordering on the leaf surface, where conditions are influenced by the metabolism of the leaf – the phyllosphere – live both pure saprophytic fungi such as Penicillia and other fungi that gradually adopt a parasitic life as the leaf ages, as well as true parasites with a varying incubation time.'

In other words, this small, confined space opened up the prospect of an entirely new research area in which the interaction between pathogen and host plant could be studied in a fundamental way; a deepening of the classical 'systematic mycological school' of phytopathology – the oldest branch of the discipline, as once practised by Westerdijk and now by Von Arx.[57]

A wealth of questions presented themselves about the phyllosphere. If a green leaf was analogous to an inn, in which vast numbers of organisms congregated, how did they interact there? What were the various life forms found on that leaf? What influence did they have on it? How did they penetrate the leaf's surface? What factors were of influence here?

The green leaf, Kerling explained in 1959, is an organ that can exhibit symptoms of disease, and at the same time it is a place for administering remedies to prevent and control disease. But how do these processes occur? Even the leaf's anatomy, ostensibly well-charted long ago, was still surprising researchers; for instance, electron microscope images had shown that so-called ectodesmata (discovered in 1939) were not simply protoplasm offshoots penetrating the cell wall in their own channels, but part of structures 'protoplasm-like in nature, consisting of fibrils, clustered close to the cuticles, terminating in a delta-like structure.'[58]

[56] In 1964 Kerling published the results: she now turned to studying the fungus populations on rye and strawberry leaves; the number of colonies increased with the age of the leaf. L.C.P. Kerling, 'Fungi in the phyllosphere of leaves of rye and strawberry', *Mededelingen van de landbouwhogeschool en de opzoekingsstations van de staat te Gent*, vol. XXIX, no. 3, 1964, pp. 885-895 (*MPLWCS* no. 50).

[57] WJPLWCS for 1960.

[58] L.C.P. Kerling, 'Het oppervlak van het levende blad en de phytopatholoog', *Mededelingen van de landbouwhogeschool en de opzoekingsstations van de staat te Gent* 24, 1959, pp. 577-592 (*MPLWCS* no. 29).

The processes that take place on or in the leaf's epidermis also proved to be extremely complex and dynamic, and to depend on plant species, light, temperature, moisture, the age of the leaf, etc. Transport and uptake of nutrients, growth regulators, inhibitors or pesticides, said Kerling, occur simultaneously – so how can they be distinguished? A great many researchers had studied aspects of these problems, but with many different plants and different nutritional solutions, which made it hard to compare the results. Only more research, said Kerling, could make it clear 'which hypotheses are correct and which must be consigned to the realm of fantasy.'[59]

Henk Sol, originally a plant physiologist, who was appointed in 1962 as Von Arx's successor, then researched the matter of whether changes in the leaf exudate in broad beans influenced their susceptibility to infection with *Botrytis fabae*. Pre-treatment of leaves with diluted sugar and a salt solution proved to increase spore germination and hence the degree of infection; the pre-treatment probably increased the permeability of cell walls, as a result of which more nutrients leaked into the phyllosphere.[60] Changes in the plant's nitrogen nutrition proved to affect the nutrients in the phyllosphere and hence infection by *Botrytis fabae*.[61]

At the same time, Joop van den Heuvel launched a major research project in 1965 on the antagonistic effects of forty different fungi and bacteria isolated from French beans.[62] It was found that over half of the isolates reduced the infection of *Alternaria zinniae* on the bean leaf – a result that did not in general correspond to the interactions found *in vitro*.

Meanwhile, in 1967, Nyckle Fokkema, first appointed by the Free University in 1965 as a student assistant, took up Kerling's earlier research line on the factors affecting the development of *Cladosporium herbarum* in the phyllosphere of rye: aside from specific substances in the leaf exudate, the presence of pollen on the leaf was also found to greatly stimulate fungus germination. 'The sudden increase in *Cladosporium* spp. and other micro-organisms on rye leaves in the field after flowering, as reported by Kerling in 1964, can be explained by the presence of pollen' was his simple conclusion.[63] It later became clear that

59 Ibid., p. 589.

60 H.H. Sol, 'Alteration in the susceptibility of *Vicia faba* to *Botrytis fabae* by various pretreatments of the leaves', *Netherlands Journal of Plant Pathology,* 1965, pp. 196-202 (*MPLWCS* no. 59).

61 H.H. Sol, 'The influence of different nitrogen sources on (1) the sugars and amino acids leached from leaves and (2) the susceptibility of *Vicia faba* to attack by *Botrytis fabae*', *Mededelingen Rijksfaculteit Gent* 32, 1967, pp. 768-775 (*MPLWCS* no. 67).

62 J. van den Heuvel, 'Antagonistic effects of epiphytic micro-organisms on infection of dwarf bean leaves by *Alternaria zinniae*', PhD thesis Utrecht, 1970.

63 N.J. Fokkema, 'The influence of pollen on the development of *Cladosporium herbarium* in the phyllosphere of rye', *Netherlands Journal of Plant Pathology,* 1968, pp. 159-165 (*MPLWCS* no. 69).

pollen stimulated not only the growth of saprophytic fungi, but also infection by necrotrophic pathogens.[64]

The number of fungi, yeasts and bacteria on the leaf varied wildly in response to different weather conditions, Kerling had established in 1965: 'and even the results of experiments conducted with plant material cultivated uniformly in glasshouses displayed rapid changes in response to weather conditions. For instance, the quantity of exudate secreted by comparable *Vicia faba* leaves was found to depend on the amount of cloud: more exudate was obtained on a sunny day than on a day with overcast skies, and atmospheric humidity also proved to be an important factor in the production of exudate.'[65]

This type of fundamental phytopathological work could now be done at Baarn, declared Kerling. This meant that Baarn was now a fully-fledged research institute – functionally and in terms of achievement on a par with any university institute anywhere. But the dynamics of this fundamental work called for constant innovation: 'the deeper you delve into a particular line of enquiry, the more refined your methods need to be to answer the next question that arises.'[66]

Singing. From left to right: Doekle Elgersma, Joop van den Heuvel, Gerard de Leeuw, Henk Sol, Ton de Lange, Bob Schippers, September 1966. Reproduced by courtesy of Koen Verhoeff.

64 N.J. Fokkema, 'The effect of pollen in the phyllosphere of rye on colonization by saprophytic fungi and on infection by *Helmithosporium sativum* and other leaf pathogens', *Netherlands Journal of Plant Pathology*, 1971, suppl. no. 1; Warren, R.C. (guest researcher), 'The effect of pollen on the fungal leaf microflora of *Beta vulgaris* L. and on infection of leaves by *Phoma betae*', *Netherlands Journal of Plant Pathology*, 78, 1972, pp. 89-98.

65 WPLWCS for 1965.

66 Ibid.

The term 'phyllosphere', said Kerling in 1958, had been devised by analogy with the existing term 'rhizosphere', denoting 'the surroundings of the plant's root, in which may be found a non-parasitic, highly-developed flora.'[67] Research into the rhizosphere, defined as 'the area within the influence of the root excreta', was new to Baarn. It did not fully mature until the 1970s, but it originated at this early stage, as a precursor of research on the ecology of soil pathogens.

Research on soil pathogens and their mutual influence in the soil had been done before – Van Luyk's antagonism research, for instance, and many of the PhD research projects studying the influence of external conditions on the development of typical root diseases, carried out under Westerdijk's supervision. But as a separate specialism, soil biology had attracted renewed attention after the war.

In Baarn too, the soil developed into a separate research field. Bob Schippers, who had been appointed in 1959 and who obtained his PhD with a thesis on virology in 1963, became the driving force behind this research line in the later 1960s. Like most members of staff who were awarded doctorates under Kerling's supervision, Schippers had gone to work in the United States for a year immediately following the defence of his dissertation, so that he was familiar with the latest developments in phytopathology. It was largely his experience at a conference held in Berkeley in 1963, the International Symposium on Factors determining the Behaviour of Plant Pathogens in Soil, that made him decide to specialize in this complex form of soil biology.

A plant's root, like a green leaf, is a vital organ for the uptake and transport of nutrients. And on the surface of the green leaf, just as in the vicinity of plant roots, a large quantity of organisms coexist. The new rhizosphere research focused on questions that were less concerned with the disease process than with the enabling conditions: how did the mutual influences work among that entire complex of soil organisms, the state of the soil, the physiology of the roots, and external conditions? How do soil pathogens survive in the soil? How is it possible that the presence of a soil pathogen may trigger symptoms of disease in one case and not in another? What role do plant exudates play in this process? What organisms are involved?

One of Baarn's first projects in this field was carried out by Gé van den Ende. His PhD thesis had been on the behaviour of *Verticillium* as a soil-inhabitant.[68] *Verticillium*, he wrote, was known as a widespread pathogen. Several

[67] Kerling op. cit., 1958, p. 402.

[68] G. van den Ende, 'Untersuchungen über den Pflanzenparasiten *Verticillium albo-atrum* Reinke et Berth', *Acta Botanica Neerlandica* 7, 1958, pp. 665-740 (*MPLWCS* no. 21).

Party celebrating Van den Ende's doctorate, 1957. Archives of the WCS, Haarlem.

other researchers had shown that under natural conditions, *Verticillium* could survive in different host plants – the fungus scarcely 'specialized' to any significant extent. The fungus penetrated the plant through the root hairs, after which it spread through the plant. *Verticillium* was therefore classified as a soil pathogen. Van den Ende made an in-depth study of the fungus's morphology, physiology and virulence, and devoted a small section of his thesis to the survival of *Verticillium* in soil.

In a follow-up study, Kerling and guest researcher Dr Alberto Matta found that *Verticillium albo-atrum* could infest the common weed *Senecio vulgaris* without the plant appearing to suffer much damage. An infested plant did not grow quite as well, and the bottom leaves died earlier than those of a non-infested plant, but for the rest, distinguishing a diseased plant from a healthy one at sight was no easy matter. Yet after infestation the fungus could be isolated from any part of the diseased plant, 'even from the achenes'.[69]

Earlier experiments had shown that the fungus only succeeded in spreading through the infected achenes and infecting other *Senecio* seedlings if placed in

[69] A. Matta and L.C.P. Kerling, '*Verticillium albo-atrum* as a parasite of *Senecio vulgaris*', *Netherlands Journal of Plant Pathology,* 1964, pp. 27-32 (*MPLWCS* no. 45).

sterilized soil: if it fell on soil exposed to the open air – which therefore might contain other micro-organisms – the fungus did not develop.[70] In general, there were two possible explanations for the lack of fungal growth in natural soil, wrote Schippers: either the soil contained 'inhibiting substances' that impeded the development of the fungus or the soil lacked certain substances that the mycelium of the fungus needed to grow.[71]

'This was the first piece of research with a purely ecological line of enquiry and approach', states Schippers. 'This new approach related primarily to the fungus's survival in the soil. It was only later, however, that we started focusing exclusively on the rhizosphere.'

The rhizosphere was first mentioned explicitly as a research field in a publication on studies of the significance of certain exudates to the development of resistance.[72] This project too focused on the highly complex interaction between the properties of the fungus, changes in the soil and the host plant: it had an 'ecological slant', as Kerling put it. 'In seeking to identify the antagonists of pathogenic soil fungi, efforts are made to influence the microbiological activity of natural soil to encourage the growth of antagonists that may be able to inactivate parasite spores, for instance. How such micro-organisms behave in a root's rhizosphere, where exudates may actually tend to foster germination, is unclear. Interaction in the soil is such a complex issue that the progress made in research is necessarily very slow.'[73]

There was another complication: this research was so fundamental in nature that there was a danger of losing sight of related problems in agriculture. 'The gap that has arisen between this fundamental research at university and the practical activities of plant pathologists is very wide indeed', said Kerling in her farewell lecture in 1970. 'Thinking back to the early stages of phytopathology research, in which pathogens had to be discovered and their life cycles clarified, one may well wonder if it is still worthwhile teaching today's phytopathology students the methods devised at the time. …On the other hand, one may expect a university graduate in phytopathology to be capable [of using such methods] to conduct more incisive research.' But 'to arrive at anything approaching a reliable result, counts and measurements have to be repeated so

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70 B. Schippers and A.K.F. Schermer, 'Effect of antifungal properties of the soil on dissemination of the pathogen and seedling infection originating from *Verticillium*-infected achenes of *Senecio*', *Phytopathology,* 1966, pp. 549-552 (*MPLWCS* no. 60).

71 Ibid., p. 552.

72 B. Schippers and J.S. Voetberg, 'Germination of chlamydospores of *Fusarium oxysporum* F.sp. pisi race 1 in the rhizosphere, and penetration of the pathogen into roots of a susceptible and a resistant pea cultivar', *Netherlands Journal of Plant Pathology*, 1969, pp. 251-258 (*MPLWCS* no. 74).

73 L.C.P. Kerling, *Fytopathologie in een veranderende wereld*, farewell address given in the auditorium of the Singer Memorial Foundation, Laren (North Holland), 28 May 1970, pp. 6-7.

frequently … that others [students and readers] learn little more about it … than that "research is a laborious business".'[74]

It remained necessary to strike a balance between these two branches of phytopathology – the "laborious", pure work on the one hand, and the classical, practical work on the other.

VIRUS RESEARCH

Virus research did not in fact become possible in the Phytopathology Laboratory until after the sweeping renovation work carried out in the late 1950s. 'Students must be able to familiarize themselves with virology', Kerling had written in a memorandum to the university's board of governors.[75] 'Until now, they have been unable to do so.'

Given that in the course of her career she had worked in various parts of the world, together with researchers from widely divergent backgrounds and very different skills, Kerling can lay title to being the first scientist to have entered the Phytopathology Laboratory with knowledge and experience in the field of virus research. And the vast majority of 'Communications' issued between 1960 and 1970 related to research on viruses.

The first 'virus' member of staff was Wim Graafland, appointed in 1953. To familiarize himself with this complex specialism, he had started by spending some time at the Institute of Phytopathological Research in Wageningen. After that he had eliminated the teething troubles that had been plaguing the new virus glasshouse in Baarn.[76] Together with Hendrien Brants, who had started work at Baarn in 1957, he had taken charge of the virus lab classes, which he led until his death in 1962. Brants then took over, with Gerard de Leeuw as her assistant; in 1963 she became the first scientist to be given an official position as lecturer in plant virology at the University of Amsterdam. After obtaining her PhD she had gone to the United States in 1961 on a NATO scholarship, and returned to the Netherlands 'with a wealth of experience' – 'which will be of benefit to our laboratory', as Kerling wrote enthusiastically.[77]

The virus research made up a large, virtually undeveloped terrain for fundamental research. 'It looks like a fast-flowing river: anyone who cannot keep his head above water will sadly drown', wrote Brants in her address.[78] How

74 Ibid., p. 8.
75 Kerling to Presidium UVA, 25 November 1954, GAA 279, inv. nos. 570-106.
76 WJPLWCS for 1957.
77 WJPLWCS for 1962.
78 D.H. Brants, *Samenspel in de plantevirologie*, public lecture given on accepting the position of lecturer in plant of virology at the University of Amsterdam, 22 October 1963.

Virus glasshouse, c. 1960. Reproduced by courtesy of Hendrien Wieringa-Brants.

and where does the virus penetrate the plant? How does it spread through the plant? What viruses are there? What is their mutual relationship? How do environmental factors influence the infection? How do different viral infections interact in the plant? And the classic question: how can viral diseases be controlled?

One of the difficulties involved in virus research, said Brants, was the impossibility of culturing viruses outside the living cell. This meant that experiments always involved the use of press juice from diseased plants, which contained the virus. So to use pure virus, virus purification with an ultracentrifuge was needed. To see exactly what the virus looked like called for the use of an electron microscope, and the transport of a virus in the plant could only be followed using radioactive isotopes. In other words, research on viruses relied on expensive and advanced technologies; this was a field in which progress was directly proportional to the acquisition of new equipment, as Kerling put it. Whenever Baarn needed some piece of apparatus it did not possess, it was compelled to collaborate with other institutes.

Various aspects of the course of viral infections were studied in Baarn over the years. Brants's PhD research showed that damage to the leaf of a tobacco plant accelerated the transport of tobacco mosaic virus within a certain period.[79] The reaction of the plant to the damage evidently influenced the virus: active cells – those busily recovering from the damage – attracted viruses. This corroborated reports in earlier literature: only those parts of the plant that were in an active state, undergoing mitosis, are attacked by viruses. Mature parts of the plant do not become diseased, but they are active in the transport of the virus. When these experiments were repeated using C^{14}-labeled virus, these results were confirmed.[80]

With the aid of these isotopes, a relationship could also be demonstrated between the quantity of visible ectodesmata and the distribution of viruses on the leaf. These ectodesmata, Brants suggested, echoing Kerling's previous studies, might prove to be the infectable sites, the plant's 'portals of entry for virus'.[81] 'These too exhibit a picture that fluctuates sharply under the influence of external conditions affecting a plant before or during the experiment,' wrote Kerling about the findings of this research.[82] 'The same results were found in research on parasites in the soil, an extremely complex environment. Changes in conditions in the space in which an experiment is being conducted also lead to changes in the physical, chemical and biological processes that take place in the soil, so that external conditions also influence the relationship between root system and pathogen.'

Unrelated to this was the observation that no virus was found in the dividing meristematic cells of some plants with viral disease, including economically important ones such as potato and freesia. The reason for this was unclear, but the phenomenon made it possible to grow virus-free potatoes and freesias by removing the uppermost tips of the meristems and cultivating them separately. The resulting plants would be free from viral disease. It was a complicated technique involving measurements of tenths of millimetres, but a successful trial was run in Baarn after researchers including Rie Quak had gained experience with it at the Institute of Phytopathological Research (IPO) in Wageningen and others likewise at the Bulb Research Centre in Lisse.[83]

Thus, in addition to fundamental knowledge, the virus research conducted in Baarn also produced practical results. Furthermore, the different research

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79 D.H. Brants, 'The influence of meristematic tissue and injuries on the transport of tobacco mosaic virus in *Nicotiana tabacum* L. cultivar Samsun', *Acta Botanica Neerlandica,* 1961, pp. 113-163 (*MPLWCS* no. 34).
80 D.H. Brants, 'Transport of C^{14}-labeled tobacco mosaic virus in tobacco leaves', *Virology,* 1963, pp. 388-390 (*MPLWCS* no. 47).
81 D.H. Brants, 'Relation between ectodesmata and infection of leaves by C^{14}- labeled tobacco mosaic virus', *Virology,* 1965, pp. 554-557 (*MPLWCS* no. 54).
82 WJPLWCS for 1965.
83 WJPLWCS for 1967; L.C.P. Kerling, 'Phytopathologisch Laboratorium Willie Commelin Scholten 1894-1969', *MPLWCS* no. 75, 1969, p. 38.

projects were found to overlap in unexpected ways. The discovery, for instance, 'that a fungus grown in vitro can be infected with a virus that probably multiplies in the hyphae', shed new light on the possibility that viruses could spread through fungi in the soil. 'Such a host-virus system can be studied in vitro under different conditions', wrote Kerling.[84] It also confirmed the idea that more cooperation was essential between people working in different specialist areas – even if the number of research projects would have to be reduced as a result.[85]

ELM DISEASE – OR VASCULAR PARASITISM

The research on elm disease – by then the oldest ongoing research project at the Phytopathology Laboratory – was also affected by the growing tension between the demands of fundamental and practical research. Of abiding importance were the efforts of Went's successor, Hans Heybroek, to grow resistant elm seedlings in the 1950s and 1960s, even though he had officially been seconded to Baarn by De Dorschkamp Forest Research Station.

This research proved successful. After the Christine Buisman elm in 1936 (a beautiful tree, but susceptible to *Nectria cinnabarina*) and the Bea Schwarz elm in 1947 (fairly resistant, but not so attractive), it yielded two more resistant trees: the Commelin elm in 1957 and the Groeneveld elm in 1963. But work of this kind was very time-consuming and involved a great deal of drudgery. To conduct, at the same time, 'fundamental work … on the factors that determine the resistance and susceptibility to *Ophiostoma* of an elm, with the ultimate goal of accelerating the work of selection', TNO gave the Phytopathology Laboratory a separate grant in 1957, initially for three years, and later renewed it for a further three years.[86]

'The complete process of selection may take as long as 22 years before a clone can be released', wrote Victor Tchernoff, who was in charge of this research from 1958 onwards. 'Many difficulties have been encountered.'[87] The most important thing was still that young seedlings frequently displayed no signs of disease after inoculation, and yet proved susceptible to the disease at a far later stage in their development. Perhaps the elm possessed what was known tentatively as 'juvenile resistance' – a hypothesis that urgently needed to be tested. It was therefore necessary, wrote Tchernoff, to review the methods

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84 Ibid., p. 38.
85 WJPLWCS for 1968.
86 WJPLWCS for 1957 to 1963.
87 V. Tchernoff, 'Methods for screening and for the rapid selection of elms for resistance to Dutch Elm Disease', *Acta Botanica Neerlandica,* 1965, pp. 409-452 (*MPLWCS* no. 56).

used critically, and to conduct further meticulous research on the morphology, physiology and virulence of the fungus, as well as on the effectiveness of different inoculation methods, the influence of environmental factors, and the method for propagating promising seedlings – as a result of which elm disease research may well be the most replicated field in the history of experimental phytopathology.[88]

In the event, Tchernoff spent six years working on an improved, standardized and faster method for testing resistant elms. Provided that one adhered to the 'ten commandments' he developed, which prescribed the best conditions for effective testing, the procedure he developed proved very successful. [89] He had also disproved the validity of the 'youth resistance' theory along the way.

But what factors did determine the resistance of elms to *Ceratocystis ulmi*?[90] That was one of the questions that Doekle Elgersma, appointed in April 1965, set out to answer. While Heybroek was turning out resistant clones at an impressive rate using Tchernoff's method, Elgersma collected vascular sap from inoculated elms, both diseased and healthy; he determined amino acid and sugar content, established their identity using paper chromatography, and tried to follow anatomically the development of the pathogen through the vascular system.[91]

Now, as what Kerling called a 'vascular parasite researcher', he could focus on *Ceratocystis* as a vascular parasite: 'the transport of the parasite within the plant and the reactions of the plant tissue to the presence of the fungus are now being studied in a fundamental way.'[92] And what a wonderful coincidence: 'transport was also an important theme in virus research on the transport and synthesis of tobacco mosaic virus in fungal hyphae.'[93]

An early highlight in this 'more fundamental side of the research'[94] was the publication in 1965 of an article entitled 'Phytotoxins isolated from liquid cultures of *Ceratocystis ulmi*', in the prestigious journal *Science*. In this article, Cornelis Salemink and Henk Rebel of Utrecht University's Organic Chemistry Laboratory, together with Kerling and Tchernoff of the Phytopathology

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88 With an average of one publication a week for 65 years (3,500 publications in total), elm disease is certainly a much-described and much-researched phenomenon in the international phytopathology community. See also F.W. Holmes and H.M. Heybroek, *Dutch Elm Disease: The Early Papers, Selected Works of Seven Dutch Women Phytopathologists*, APS Press, 1990, p. 8.

89 V. Tchernoff, *op. cit.* 1965, pp. 442-443.

90 The term *Ceratocystis* has been retained here, since this is the name by which the pathogen was known during many years of research at Baarn. The term *Ophiostoma* was adopted much later.

91 WJPLWCS for 1965.

92 WJPLWCS for 1965 and 1968.

93 WJPLWCS for 1968.

94 WJPLWCS for 1964.

Laboratory, described the results of their successful attempt to isolate the phytotoxic components from 'liquid cultures' of *Ceratocystis ulmi*.[95] 'This compound induced disease symptoms, similar to those produced by the fungus itself, in elm sprouts and trees,' they wrote.

If there is one research line that illustrates the significance of the new trend, it is the history of elm research at Baarn. In the course of the 1960s the research topic shifted permanently away from diseased elms to 'genetically uniform elm callus cuttings', regarded as the vehicle that could help to answer fundamental questions on the nature of vascular parasitism.

Though this shift of emphasis was not complete until the 1980s, it began twenty years earlier. The focus was no longer on the disease itself or even the disease process, but on the underlying mechanism of disease. Clarifying this mechanism called for a bigger and bigger arsenal of increasingly expensive equipment: 'For our research on events in the phyllosphere and rhizosphere, it is now desirable to obtain the use of chambers in which temperature, lighting and moisture can all be regulated. Research teams studying vascular parasitism will also want to use apparatus of this kind in the near future', wrote Kerling in 1966.[96] 'We are thinking of equipping two climate chambers and four climate cabinets.'

The Laboratory had been greatly expanded and completely overhauled only two years earlier. All kinds of modern apparatus had been purchased, and two new rooms had been equipped as laboratories. The materials grants allocated by the universities had soared sky-high in the previous period. Now the Laboratory wanted to invest in a fresh battery of expensive equipment. 'As for the high cost of the apparatus desired, it should be noted that at present the tests are frequently too irregular to permit any conclusions to be drawn from them,' said Kerling by way of justification. 'Cultivating plant material, the space this material takes up in the greenhouse, and the time spent on the experiment by the researcher are all loss-making activities, not to mention the disappointment of the researcher and that of the student, if his own experiments are concerned.'[97]

This was simply the dynamic nature of fundamental research: every answer raised new questions – the deeper one penetrated into the essence of things, the more refined was the method required to answer these new questions. The underlying question remained, who was to pay for all this? And who should decide who paid?

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95 C.A. Salemink, H. Rebel, L.C.P. Kerling and V. Tchernoff, 'Phytotoxin isolated from liquid cultures of *Ceratocystis ulmi', Science*, vol. 149, 1965, pp. 202-203 (*MPLWCS* no. 53).

96 WJPLWCS for 1965.

97 Ibid.

A changing world

Phytopathological expertise, it was said in 1953, was a scarce commodity. Any industrial concern wanting an answer to a specific phytopathological problem could apply for an answer to the Willie Commelin Scholten Phytopathology Laboratory or to one of the institutes in Wageningen, or else build its own laboratory.

Ten years later, the world looked different. 'Phytopathology is now being practised in many other places as it is being practised in Baarn', wrote Kerling in her annual report.[98] To avoid falling behind, a new round of expensive investments was essential.

'The Phytopathology Laboratory's operational costs have always been paid from the interest on its own capital. The state and the city of Amsterdam have benefited from this, so that as things stand they are indebted to the WCS.'[99] If the universities wanted phytopathology as a subject, they were going to have to pay for it, and pay handsomely. That too was the language of 1953.

In 1970, some board members considered that the grant applications to be sent to the three universities were 'rather exorbitant'.[100] Could they not manage with a little less? What was the precise basis underlying the Laboratory's finances actually – and what allocation key should be used in respect of the three universities?[101]

Kerling herself was of a frugal disposition. The objective envisaged by the founders had been to stimulate research and education, not to make a profit from it. 'It is not necessary to make guests pay top prices', she said at the beginning of her directorship; a solitary voice when the board was only calling for *more* money.[102] Eventually she found herself standing alone once again; when that same board, still populated by men from the university world, starting counting every penny. Once their generosity had known no bounds, but now a colder air had descended.

'She found it difficult', Schippers recalled. 'A faculty board like that, all prominent men who addressed each other very stiffly and formally as Professor – and that was the body she had to approach, with her slight and delicate frame, and an outsider to boot, to ask for money.'[103] The staff in Baarn did not have a clue as to what took place between their director and the corpulent university administrators amid the dense cigar-smoke of the dark senate

98 Ibid.

99 Minutes of the board meeting of 21 March 1953, archives of the WCS.

100 Minutes of the board meeting of 20 May 1970, archives of the WCS.

101 Minutes of the board meeting of 5 May 1967, archives of the WCS.

102 Minutes of the board meeting of 2 April 1958, archives of the WCS.

103 Interview with Bob Schippers, December 2004.

chambers – the centre of their professional lives was not the university in the hectic city, but the Laboratory in the leafy suburb of Baarn.

They did not hold any grandiose gatherings of their own; they did have meetings every six weeks, however, at which each member of the team discussed his or her own research projects. Amid the vast garden they could enjoy the early spring sun; they discarded their jackets and sat languidly in the grass, cups of tea within easy reach. The nearby swimming pool and Canton Park as well as the old colonial-style Villa itself provided a 'special ambience' within which students and staff could devote themselves to science in peace and liberty.

'The cherry song!' Schippers suddenly recalled. 'Every now and then we congregated in the kitchen to make cherry agar for the fungi. Then we would sing the cherry song, while working and munching cherries.'[104]

In the mid-1960s the staff started a tradition of annual outings. They were purely recreational and intended to foster good working relations. Destinations included the Delta Works, the provincial government buildings in Arnhem, and the science museum Evoluon in Eindhoven – all places where the public could admire the glorious wonders of progress.

This tradition was initiated after the staff's 1963 trip, which fulfilled a long-cherished desire: they journeyed to a number of institutes in Germany 'to familiarize ourselves with the research being done there and to strengthen ties with our neighbours.' The route led through Sauerland and Harz, 'with autumn colours basking in bright sunshine' – Miss Brants and Mr De Leeuw had coaxed their temperamental motor-cars through small towns on the way, keeping in close contact. The highlights of the 1,470-kilometer trip included Bonn, Göttingen and Brunswick.

For Westerdijk, exchanges with fellow-scientists in Germany had been part of everyday life. She wrote and spoke German as well as English, French and Italian with ease. Europe was her home front, personally as well as professionally. After the Second World War, the United States resoundingly supplanted this old Europe as the vanguard of science; all those wanting to be involved in cutting-edge science travelled in one direction only – westwards, across the Atlantic.

The neighbourly contact proved to be both delightful and inspiring. 'The visit was extremely useful to our staff', Kerling wrote later. 'Not only have personal ties been forged, but it is important to know what subjects our neighbours are working on,' adding with evident surprise, 'and they work hard, and meticulously!'[105]

[104] Meeting of the advisory committee (Commissie van Advies), 14 January 2005.

[105] WJPLWCS for 1963.

Kerling dressed as Mistress Commelin, party held to mark the 75th anniversary of the Willie Commelin Scholten Phytopathology Laboratory in 1969. Archives of the WCS, Haarlem.

On 11 December 1969, the Phytopathology Laboratory celebrated its 75th anniversary in the main auditorium of Baarn's Lyceum. The festivities revolved around the Laboratory's ties with the universities. The College of Agriculture was a dominant presence. Several board members made speeches and presented gifts: a watercolour of the first director, Jan Ritzema Bos, a certificate, a tile tableau, flower arrangements, an aerial photograph of the Laboratory.

Reminders of the past abounded, but they possessed only curiosity value. A small exhibition of old books and microscopes had been set up in a separate area of the Laboratory. It testified to a bygone age, which was now of interest only to historical enthusiasts. The director presented a little book to the board, containing her own version of the Laboratory's history. An alienating chasm gaped between then and now.

On 28 May 1970, Kerling gave her last public lecture. 'Our laboratory community is entering a new phase of its existence', she said. 'The tasks to be done in the kitchen, in the garden, in the workshop or at the typewriter were performed cheerfully from the outset, in the service of research and education,

Old and new microscope, exhibition held to mark the 75th anniversary of the Willie Commelin Scholten Phytopathology Laboratory in 1969. Archives of the WCS, Haarlem.

but today, everyone's responsibilities extend further still. Decisions are now made in mutual consultation, which for many presents a wider view of the problems facing us in the light of the 1970 University Administration (Reform) Act [*Wet Universitaire Bestuurshervorming*; WUB]. Adjusting to the new situation will take time. … Full of confidence and with my best wishes, I should like to hand over my responsibilities, but the laboratory ship is still bobbing about, waiting to see the course that will be set presently, in consultation with the new professor.'[106]

Science was no longer a matter of individuals. The ship's course was not defined. Phytopathology was part of 'a changing world', in which even the actors, the forces acting upon them, and their interaction were largely ill-defined.

[106] L.C.P. Kerling, *Fytopathologie in een veranderende wereld*, farewell address given in the auditorium of the Singer Memorial Foundation, Laren (North Holland), 28 May 1970, pp. 10-11.

7 Triangular relations

'There were three things I wanted to change', says Koen Verhoeff in a recent interview.[1] 'When I took over as director, the atmosphere at the Laboratory struck me as… how shall I put it…'. He pauses thoughtfully, and then says, nodding, 'quiet.' Folding his hands, he explains, 'After the lively surroundings of Naaldwijk Research Station and the Institute of Phytopathological Research in Wageningen, that took me by surprise. There were not many students in Baarn to inject life into the place. I was also startled to find that most people here went home for lunch. In America, I had been used to lunch breaks being used for friendly exchanges and consultations.' So the first thing to be done was to attract more students.

'I also felt that we needed to lobby for extra resources, especially from ZWO [the Netherlands Organization for the Advancement of Pure Research; now NWO].' After his index finger, Verhoeff now extends his middle finger. 'We could scarcely expect the universities to allocate any extra staff. And thirdly,' grasping his ring finger, 'we needed to encourage internal cooperation. That has a deepening effect on the research and improves your position when you're applying for external resources. Under Kerling the work had become fragmented, with everyone doing his own thing. That's not right; in science you have to work together, otherwise you don't achieve much.'

He stares ahead a little gloomily. 'There was a permanent staff of eight plus one vacancy. My aim was to have three project groups, each with three permanent members of staff. And I wanted each member of staff to have a personal laboratory technician. But that was too ambitious; I never managed to get that far.'

Koen Verhoeff took over officially as professor-director of the Phytopathology Laboratory on 16 October 1970. Kerling had relinquished her responsibilities a few weeks earlier, on 1 September, and Bob Schippers had been standing in.[2] Until then, the nomination of a new director or professor had been a professorial

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[1] Interview with K. Verhoeff, 22 February 2005.

[2] WJPLWCS for 1970.

Koen Verhoeff, c. 1987. Reproduced by courtesy of Koen Verhoeff.

prerogative. Board members sounded each other out about suitable candidates, occasionally seeking recommendations from former students or staff members, and eventually nominated a candidate. 'That was how we all got in', recall former staff members. '"So you would like to do your PhD thesis here?" Kerling would ask. "Yes, professor." "Very well then." And then she would find you a subject to research. Or if you had an idea of your own, you could do that, usually.'[3] Recruitment, applications, selections, appointment negotiations, salary classifications – none of that existed, let alone anything as bureaucratic as personnel policy. The academic community was small and everyone knew everyone, although you kept your distance by using formal modes of address like *u* and *Professor*.

By about 1970, this small cosy atmosphere had vanished. Today, if you enter the name 'Verhoeff' in the database (Documentaire Informatievoorziening, DIV) on the third floor of the university's administrative headquarters, the 'Maagdenhuis' building in Amsterdam, you are given the number of a case file, which contains all the papers relating to the appointments procedure. It turns out to be a small file, but it does provide the interested outsider with clear-cut answers to all the questions that one might have about this director's appointment, over 35 years ago. The file reveals, for instance, that the decisive factor in Verhoeff's appointment had been managerial skill. That is why the other serious candidate for the position, deputy director Bob Schippers, had ended up in second place.

What this file does not reveal, however, is that Verhoeff's nomination put the finishing touches to a long series of diverse choices made by various individuals in the years before. Although each decision ostensibly stood alone, retrospectively they can be seen as building up towards this last choice, answering a single question: 'What does the Willie Commelin Scholten Phytopathology Laboratory need most at this moment in time, an outstanding researcher or a manager?'

Having your cake and eating it… and eating it again!

By 1970, the Laboratory's status and its location had been the subject of debate for years. Baarn was increasingly seen by the universities as very remote: students from Amsterdam or Utrecht wanting to do research there had to

[3] Interviews with B. Schippers (25 January 2005, 10 February 2005) and N.J. Fokkema (7 February 2005); the same applied in Wageningen, as emerged from interviews with Professor J. van der Want (professor emeritus of plant virology at the Agricultural University, 16 March 2005), and Dr F. Quak (former head of the department of plant virology at the Institute of Phytopathological Research, Wageningen, on 7 March 2005).

spend at least an hour and a half travelling back and forth every day. All this travelling was not only time-wasting but expensive – the universities footed the bill.

On top of this, Baarn had broached the need for another round of major investments, including eight new climate cabinets, two new climate chambers and an electron microscope. Might it not be better, suggested Utrecht University's board of governors at the beginning of 1969 – mindful of Kerling's forthcoming retirement in 1970, and with a view to pre-empting the procedure to appoint a new professor of phytopathology – to look into the idea of appointing a professor at the university itself, with his or her own laboratory?

This was basically an offshoot of an issue that had been exercising minds for years: the funding of the Laboratory. Since 1954, when the Laboratory had been radically renovated and upgraded at the Foundation's expense, the universities had been paying rent to the Foundation for the use of its buildings. The Central Bureau of Fungal Cultures (CBS) had also paid rent, as did all other institutions that seconded researchers to the WCS. In addition, the universities contributed towards the costs of furniture and equipment. They also paid the salaries, of course, of all research and support staff appointed by them. Personnel whose tasks were confined to maintenance of the building, however, such as cleaners, painters, and for some time now security guards, were paid by the Foundation, which also paid a proportion of the telephone, gas, electricity and water bills.

This construction had gradually changed. The CBS had moved to new premises in the early 1960s. Researchers seconded to the Laboratory by commercial companies were few and far between. This basically meant that the Laboratory was now exclusively a university institute. 'All the Laboratory's operational costs are now incurred for the benefit of the researchers appointed to the universities and for teaching students', Kerling wrote to the Presidium of the University of Amsterdam in 1966.[4] So it was reasonable to expect the universities to pay the telephone and electricity bills, which were still being charged to the Foundation.

In principle this reasoning was perfectly sound, replied the Presidium, and the university was willing to shoulder its burden where gas, water and electricity were concerned (not the telephone bill, however, which the Foundation should take from the annual rental charges). But the Free University would have to bear its share as well.[5] And it had not done so to date.

The Free University had a 'separate arrangement' with the WCS Foundation. Like the universities of Amsterdam and Utrecht it paid rent (less, because of

[4] Kerling to Presidium UVA, 27 June 1966, Maagdenhuis UVA, DIV, file VII, 1967, WCS.

[5] Presidium UVA to Kerling, 30 August 1966, Maagdenhuis UVA, DIV, file VII, 1967, WCS.

its relatively small student numbers; there was a fixed allocation key of 3:3:2). In addition, it set aside an annual sum, from 1965 onwards, to pay for one researcher and one laboratory technician, besides which it provided a general grant (5,000 guilders in 1966). It did not contribute, however, to investment credit, new equipment, furnishings, or any of the Laboratory's unforeseen expenditure. Essentially, then, the Free University had no involvement in (and did not pay for) the Laboratory's *development*. It provided some money every year, but did not appear to worry about how it was spent. Furthermore, it contributed far less than the Laboratory's other users.

A brief review of the figures will illustrate just how skewed the situation had become.[6] In 1967, the money deposited in the procurement fund (used to purchase instruments and for other major material investments) came from the following sources: 31,750 guilders from the University of Amsterdam (UVA), 27,316 from Utrecht University (UU), and a mere 5,000 from the Free University (VU). In terms of salaries: the UVA and UU together funded one professorship, to which the VU did not contribute; the UVA paid for one senior lecturer, to which neither the UU or VU made any contribution. The UU compensated for this by spending a total of 126,706 guilders on research staff, as opposed to the UVA's 88.356, but here too, the VU, contributing only 22,000 guilders, lagged far behind.

If all the Laboratory's operational costs were incurred for the benefit of university research and education, argued the Presidium, and if the Laboratory was therefore comparable in structure to an inter-university institute, then it was reasonable to expect a more equitable distribution of the burden. Specifically, every university should pay in due proportion according to the number of biology students enrolled, and the number of places for staff should also be proportional to these numbers. So, on the basis of 16 students enrolled at the UVA, 18 at the UU, and 5 at the VU (in 1967), the UVA was paying almost 20,000 guilders too much, the UU over 2,000 too much, and the VU over 20,000 too little. This led to a bald conclusion: 'The distribution of the costs is arbitrary.'[7]

In response, at its annual meeting of 5 May 1967, the board of the Foundation immediately set about making some calculations of its own.[8] If the number of registered biology students was to be the criterion, this would mean increasing the contribution paid by the UU, which had always had the largest number of biology students. But the number that came to

6 Presidium UVA to Kerling, 9 September 1966, Maagdenhuis UVA, DIV, file VI, 1966, WCS.

7 Presidium UVA to Kerling, 9 September 1966, Maagdenhuis UVA, DIV, file VI, 1966; these figures relate to the biology students who attended the six-week course in phytopathology in Baarn.

8 NWCS, 5 May 1967, archives of the WCS.

work in Baarn was roughly equal to the number from the UVA. It would be fairer, suggested the board member from the College of Agriculture, to use the average number of students who came to work in Baarn as the allocation key. But that would call for a lot of calculations retrospectively. Perhaps it would be better to divide the funding in two, suggested the VU delegate: an annual fixed sum for each university, plus a variable amount depending on the number of students that came to work at the Laboratory. But how should the allocation key be decided? The board decided to delegate the matter to the representatives of the UVA, VU and UU.

Just how chaotic the contributions had grown became apparent at these representatives' first meeting.[9] Since 1954, the UVA had been paying, in addition to rent, separate sums of money for books, furnishings, entertainment expenses, and excursions; then there were other sums earmarked for various accessories and special purchases. Kerling applied for each one of these grants separately on a printed form each year, each one furnished with explanatory notes, and every year the Presidium decided whether or not to agree to fund each separate item. In recent years, some of the requested grants had changed during the financial year: the price of a freeze-drying installation had fallen, for instance, or it had been decided that it was more important, after all, to buy some more scales or a refrigerator instead of the centrifuge that had been budgeted. Every new change had to be passed on and assessed.

In short, the entire funding operation generated an enormous quantity of paperwork – and that was only for Amsterdam! Utrecht had its own budgetary rules. For electricity, water, telephone and gas (unpredictable items of expenditure) separate bills were despatched every three months, and a completely different procedure applied in the case of applications to hire extra personnel. No wonder that the board of the WCS Foundation awarded Miss Van der Weide a bonus every year, 'for her excellent bookkeeping.'[10] A lesser woman would have lost her mind.

The entire grants system would have to be simplified, decided the delegates. To start with, the director could draw up just one budget a year instead of applying to the universities for a whole battery of different grants. And if an allocation key could be agreed between the three universities for their permanent use of the facilities (such as the 3:3:2 key used for rent and electricity), and a different one based on student numbers, the university administrators would only have to consider that one budget, leaving the rest of the calculations to their officials. This would all be perfectly simple. How the universities could continue to have

9 Minutes of the meeting attended by J.H. des Tombe (UU), Dr F. Bender (UVA) and C.N. Doets (director, VU) on 27 October 1967 and 12 December 1967, Maagdenhuis UVA, DIV, file VII, 1967.
10 E.g. NWCS 17 May 1965, archives of the WCS.

a finger in the pie if they could no longer influence the way the money was spent – that was a problem to be tackled later on, they added in passing.

On 11 March 1969 the delegates resumed their consultations; two of them were new, as a result of recent changes on the board.[11] This time, however, the most important matter to be discussed was no longer the solutions devised at previous meetings, but a letter from the board of governors to Utrecht University stating that it first wanted to investigate whether it would not be better to appoint its own professor of phytopathology, with his or her own laboratory, which would mean leaving the Baarn premises altogether in favour of a new laboratory on the university campus.

The University of Amsterdam turned out to be toying with similar plans for 'decentralization', involving new premises to be built on the outskirts of the city. All this cast the problem in an entirely different light, said the delegates. But if the VU was also thinking of setting up its own laboratory, the net result would be three phytopathological laboratories and three professors of phytopathology instead of one. A more expensive solution was hard to imagine. As things stood, the costs incurred by the expansion in Baarn could be split three ways; there was still enough space in Baarn, and so much had been invested already. Would it not amount to an enormous destruction of capital to opt for separate resources?

The delegates decided to consult their colleagues. They sent a letter to the faculties of the three universities, the College of Agriculture, the Institute of Phytopathological Research, and the Plant Protection Service, explaining the background and asking them which solution they favoured: decentralization or preserving the existing unity?

The minutes of the following board meeting of the WCS read: 'All those replying agreed that dividing up the phytopathology facilities was undesirable and urged the continuation of the existing cooperative framework between the three universities and the Willie Commelin Scholten Foundation in Baarn, with the possibility of developing it into a inter-university institute.'[12] The staff of the Laboratory in Baarn had sent in a report of its own, 'pointing out the advantages of the status of inter-university institute.'[13]

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[11] J. Drechsel had replaced Dr F. Bender, and D.N.C. van Wijk had replaced J.H. des Tombe.

[12] NWCS 20 May 1969, archives of the WCS; replies were received from the faculty of mathematics and natural sciences, also on behalf of the biology subfaculty at the UU, the biology subfaculty at the UVA, and the directors of the VU, as well as the following persons from Wageningen: Prof. J. Dekker, Phytopathology Laboratory of the College of Agriculture, Dr J.G. ten Houten, Institute of Phytopathological Research, and Dr N. van Tiel, director of the Plant Protection Service.

[13] Quotation from minutes, 'Doelstellingen en structuur van het onderwijs in de fytopathology', Report issued by the research team of the WCS Phytopathology Laboratory, April 1969, Utrecht University Museum, 402, 1.7.

Did this safeguard the continuity of the Laboratory? It certainly did, felt the chairman of the board. So the committee mandated to nominate a successor for Kerling could get down to work. The board wound up this discussion with no small sense of relief, leaving the complicated issue of the Laboratory's financing arrangements unresolved. No new allocation key was agreed, nor was one ever proposed.

The appointments committee was composed of the following professors: Durk Stegwee and Louise Kerling for the UVA, R. van der Veen and J. van Die for the UU, and Leendert Algera for the Free University, with the chairman of the Willie Commelin Scholten Foundation, Jo Oort, who was also professor of phytopathology at the College of Agriculture in Wageningen, representing the Foundation.

The committee met three times.[14] The first point of discussion was recruitment: it was decided to advertise in the *Vakblad voor Biologen* and the *Netherlands Journal of Plant Pathology*, the successor journal to the Dutch-language *Tijdschrift over Plantenziekten*. Then there was the job profile: the committee opted for a phytopathologist who was specialized in the subdiscipline of mycology, considering that the other subdisciplines, virology and nematology, were represented adequately in Wageningen. As for educational qualifications, the committee was clear that a doctorate was an essential criterion. This left only two candidates: Verhoeff and Schippers.

Verhoeff, who was then 38 years of age, had studied biology in Utrecht, while Schippers, three years younger, had studied in Amsterdam. Both had gained doctorates under Kerling's supervision: Verhoeff in 1960, Schippers (*cum laude*) in 1963. Schippers had begun – and continued – his career as a member of staff of the Phytopathology Laboratory in Baarn (with a one-year break, when he worked as a visiting researcher in Berkeley, followed by a tour of the United States, in 1964). Verhoeff had gone from university to the Glasshouse Fruit and Vegetable Crops Research Station in Naaldwijk, initially working part-time besides teaching at the State Secondary School of Horticulture, and later full-time, seconded from the Institute of Phytopathological Research in Wageningen. After a period working as a visiting scientist at the Glasshouse Crops Research Institute in Rustington (Sussex, UK) in 1964, and a study trip around the United States in 1966, Verhoeff had been appointed head of the department of mycology and bacteriology at the Institute of Phytopathological Research (IPO) in Wageningen.

[14] On 19 June, 31 October and 1 December 1969; file 'Commissie Voorbereiding opvolging professor Kerling'; report of 11 December 1969, Maagdenhuis UVA, DIV.

‘I was not happy there’, he recalls. ‘When the director of the IPO fell ill, I replaced him for a long time. All that management work left me hardly any time for my own research, and I missed the teaching. Baarn was a real research centre, with enough critical mass, young people, an enthusiastic group. That was where I wanted to go.’

The appointments committee considered that both candidates had produced ‘outstanding’ scientific work. But while Verhoeff’s work contained perhaps slightly less incisive science, his ‘businesslike and dynamic approach’ swung the balance in his favour, with a view to the tasks he would be performing as teacher and director.[15] ‘The staff at Baarn have no objection to the nomination of Verhoeff’, Kerling informed the committee.[16]

‘It suited me fine’, says Schippers today. ‘We soon arrived at a natural division of labour. Verhoeff did all the administration, and I was mostly involved with the scientific activities at the Laboratory. That worked perfectly.’ The recognition of Schippers’s scientific qualities soon landed him a senior lecturer’s position at Utrecht University in 1972.[17] This paved the way for the research in Baarn to be clustered in project groups.

Ecologically-oriented phytopathological research

In that respect Baarn was no different from any other university department. Administrators everywhere were insisting on pooling resources and improving organizational structures, if only to clarify things for themselves. Nominally, research was no longer a matter of individual researchers – in practice, of course, the degree of collaboration depended on the attitudes of individual researchers.

‘The division into project groups went very smoothly’, says Verhoeff. ‘The scientific group – eight people at that time – was still young and flexible. Almost everyone with a doctorate had spent a year in the United States. And the Baarn Laboratory had already developed its own unique approach to phytopathology; one that centred on the interaction between plant, pathogen and the environment. The nucleus of each team had also become clearly defined by that stage. Building on this, it was quite easy to form three teams: one focusing on ecology, one on physiology, and one on virology.’

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[15] GAA 279.A, inv. 913.

[16] File ‘Commissie Voorbereiding opvolging professor Kerling’; report of 11 December 1969, Maagdenhuis UVA, DIV.

[17] WJPLWCS for 1972; KB of 5 December 1972.

Research staff and assistants in the garden of the WCS Laboratory in 1980.
From left to right: H. Kanning, N.J. Fokkema, R. Svaldi (Italy), J. Meijer, R.J. Scheffer, A.J. Schreuder, D.H. Wieringa-Brants, J. van den Heuvel, A. Dijkstra, B. Schippers, G. van der Kemp, K. Verhoeff, L. Waterreus, G.T.N. de Leeuw, J.A. Isaacman-Glazener, J. van Garderen-van der Broek, H.J. Walgreen, E.A. Weststeijn, M. Hut-de Ruijter, A. Kramer, W. Liersen, C. Smeekes, J.I. Liem, D.M. Elgersma, and squatted on forefront: W.G.M. Schellingerhout-Huyg, M.A.C. Papenburg-de Weijer.

Baarn and Wageningen did in fact have different approaches to phytopathology. The Institute of Phytopathological Research, for instance, had developed a research structure in which the pathogen, rather than the diseased plant, was the central object of study. The Institute was composed of departments corresponding to different kinds of plant enemies: bacteriology, virology, nematology, mycology, entomology, and a department of physical-chemical influences (air pollution). The research focused partly on the pathogen's effect on the plant, and to a large extent also on the possible ways of controlling it.

The College of Agriculture had different accents of its own. It had a team researching the functional mechanisms of crop protection products. Another team focused on the epidemiology of diseases, and a third on effects of composting on the survival of pathogenic fungi.

Generally speaking, the Baarn team saw the biology of the diseased plant as their central concern, while those working in Wageningen considered their main task was to study diseases and the ways of controlling them. What is more, the fact that the College of Agriculture and the Institute of Phytopathological Research came under the Ministry of Agriculture, administratively speaking, while the Phytopathology Laboratory – as an inter-university department – came under the Ministry of Education, Arts and Sciences, fuelled the notion that Wageningen was more concerned with 'applications' while Baarn concerned itself with 'fundamental science'.

'The phyllosphere research we did in Baarn, for instance; that would never have been possible in Wageningen', says Fokkema.[18] 'It was absolutely not geared towards practical applications – certainly not at the beginning, in any case. It was driven by pure scientific curiosity, and it was really very exciting. Pushing back frontiers, new. And absorbing.'

A small drawing presents the subject studied by this first project group in schematic form: a few lines denote the side view of a plant, with its roots in the earth and its leaves in the air. The surface of the soil forms a thick line that divides the plant in two – one part above ground, the other part below. The well-informed outsider sees immediately that the existing phyllosphere and rhizosphere research has been combined into a single project group here. It may be added that this project group did not present itself with a single research line until 1977.[19]

In spite of this framework, each member retained a distinct specialism. For the ecologically oriented project group, this meant that the project leader, Schippers, continued to focus on the rhizosphere, while the phyllosphere remained primarily the province of his colleague Fokkema. The third permanent member of this team, the plant bacteriologist Ton de Lange, initially took part in the phyllosphere research, but fell ill and had to withdraw in 1977. He left Baarn altogether in 1979 and went to work for the Department of Special Botany at the University of Amsterdam. His place in the team was not filled, as part of an economy drive.

'If you want more researchers', Verhoeff had told the leaders of the teams as soon as they were formed, 'you will have to get external funding for them yourselves.' The main potential source of such funding in the 1970s was the Netherlands Organisation for the Advancement of Pure Research (ZWO), joined in the 1980s and 1990s by the European Community and the Technology

[18] Advisory committee meeting of 14 January 2005.
[19] WJPLWCS for 1977, p. 9.

Foundation (STW). So the project teams could operate fairly autonomously. Each was free to expand or modify its chosen research theme, or to link it to others. At the same time, of course, this sowed the seeds of rivalry.

Ecologically oriented phytopathology – more specifically the work of this research team – was also incorporated into the teaching programme. As part of the restructuring of the biology education under the terms of the Posthumus Act, for instance, Utrecht had launched a course on the ecology of micro-organisms in 1973, with Schippers as senior lecturer. This 'B-1' subdiscipline focused particularly on his own specialism.

'If the root microflora in the soil were to emit sounds, your faculties would desert you', Schippers put to his students. 'There are millions of micro-organisms, ranging from bacteria and fungi to actinomycetes, from protozoa to algae, living in a single gram of rhizosphere soil. All these micro-organisms are trying to survive – and each one has its own strategy for doing so. In the rhizosphere, for instance, they use the sugars and amino acids that are secreted by the plant roots. So they are in contact with the plant, at the same time as competing with the other organisms in their surroundings. The scope for a pathogenic fungus to develop on the root surface is partly dependent on the microflora present there. You can imagine how incredibly complex the interaction is among all those micro-organisms. Research into the way this eco-system functions is also extraordinarily complex, if only because you have no direct access to it. What takes place in the soil is invisible. So you need a good model if you are going to research it in some sensible way.'[20]

To begin with, Schippers, visiting scientist K.M. Old, and one of the first externally recruited PhD students, Wim van Eck, therefore focused on a simple model and an ostensibly simple question: how does a pathogenic soil fungus survive in the soil?[21]

Schippers takes a piece of paper and draws a line with a little ball below it. 'This', he says, pointing to the little ball, 'is a chlamydospore. That is a resting structure of the soil fungus *Fusarium*. These chlamydospores are large, with thick cell walls. They are full of reserves ensuring their survival.' Schippers then draws a line from the inside to the outside of the little ball, at the end of which he adds a number of dots. 'All kinds of substances slowly leak out of the chlamydospores. Other micro-organisms in the surrounding area benefit from this, which probably increases the leakage. In addition, these micro-organisms secrete substances themselves, some of them volatile.' He draws

[20] Interview with B. Schippers, 25 January 2005.

[21] In 1972, ZWO awarded a grant for the temporary appointment of J.W.L. van Vuurde as a PhD researcher, followed in 1973 by a similar grant for W. van Eck. Van Vuurde worked on a second research line, the rhizosphere.

angular brackets at each end of the connecting line, so that the soil and chlamydospore are now linked by a two-pointed arrow. 'How do these influence each other? That is what we wanted to know.' This was a purely ecological question. It was only very obliquely connected to diseased plants – the picture did not even feature a plant.

'Using an electron microscope, we were able to show that bacteria were present in the thick cell walls of certain *Fusarium* resting structures', explains Schippers.[22] 'But we couldn't tell whether they were responsible for the degradation of those cell walls, or whether they merely benefited from degradation that had already been initiated, for instance by certain endo-enzymes of the chlamydospore itself. That was the next question.' An analysis of the formation and degradation of these *Fusarium* chlamydospores became the subject of the first PhD research project in this team.[23]

Soil fungistasis, the capacity of soil to inhibit the growth and germination of fungi, was a phenomenon that intrigued much of the phytopathological community in the early 1970s. [24] A wealth of new findings was being published on this subject, especially in East Lansing, 'the world capital of the ecology of soil pathogens'. Inevitably perhaps, these findings were frequently inconsistent. Were the germination and growth of fungi inhibited, as the authoritative American phytopathologist J.L. Lockwood had been insisting for more than ten years, by other micro-organisms that were extracting essential nutrients from them?[25] Or were there volatile substances in the soil that inhibited germination – or actually fostered it, as one more recent hypothesis would have it? The Phytopathology Laboratory in Baarn, says Schippers, helped resolve this issue by establishing that ethylene did not affect soil fungistasis, but ammonia did possibly play a role.[26]

'It was an interesting beginning', says Schippers, looking at his drawing with the arrows and the little ball. 'But just soil fungistasis was not really what we wanted. We wanted to have the plant too, in my case the plant root, the rhizosphere. What really fascinated us was the overall picture: the root microflora, *and*

[22] K.M. Old and B. Schippers, 'Electron microscopical studies of chlamydospores of *Fusarium solani* f. *cucurbitae* formed in natural soil', *Soil Biology and Biochemistry*, 5, 1973, pp. 613-620.

[23] W.H. van Eck, *Formation and lysis of chlamydospores of Fusarium solani in soil*, PhD thesis Utrecht, 1977.

[24] B. Schippers, *Oecologie van mikro-organismen, een fytopathologische beschouwing*, inaugural address upon accepting the position of lecturer in phytopathology at the UU (Rede uitgesproken bij de aanvaarding van het ambt van lector in de fytopathologie aan de UU), 1973, pp. 8-10.

[25] Michigan State University, East Lansing; later on, Lockwood became a visiting scientist in Baarn, where he investigated the possible role of iron competition (siderophores) in soil fungistasis.

[26] B. Schippers and L.C. Palm, 'Ammonia, a fungistatic volatile in chitin-amended soil', *Netherlands Journal of Plant Pathology*, 79, 1973, pp. 279-281; H.J.M. Löffler, *Fusarium oxysporum in soil enforced with ammonia-generating compounds*, PhD thesis Utrecht, 1986.

the pathogen, *and* the soil flora. We started looking for a new model. That was a time-consuming business. It took years just to chart the root flora of a particular crop. One PhD student even devoted his thesis to it. But it was not until we started working with *Pseudomonas* that the work really started moving forward.'[27]

The idea of working on strains of this root-inhabiting, fluorescent bacteria *Pseudomonas* had been suggested by M.N. Schroth, Schippers' former supervisor from Berkeley. When they met at the Third International Congress of Plant Pathology in Munich, in 1978, Schroth had told Schippers about research indicating that these *Pseudomonas* bacteria suppressed the inhibitive effect of other root-inhabiting micro-organisms, the so-called 'minor pathogens'[28] or 'Deleterious Rhizobacteria'. So the net result of the *Pseudomonas* bacteria was to promote growth – in other words, they were antagonist 'plant growth promoting rhizobacteria'.

'From 1979 onwards, searching for an attractive rhizosphere model, we concentrated on the isolation and selection of these plant growth promoting *Pseudomonas* strains', relates Schippers. 'With four of them, WCS358, WCS365, WCS374, and WCS417, we struck gold, and these four have played a central role for over twenty years now.'

With the *Pseudomonas* strains, the picture was complete. What is more, within the international phytopathology community a distinct group of researchers gradually emerged who concerned themselves with similar rhizosphere problems – as well as studying these plant growth promoting rhizobacteria. With the decision to study *Pseudomonas*, Schippers and his team were at the forefront of modern research.

But how were these strains obtained? 'That was another lucky break', says Schippers. 'We got them through the Research Station for Arable Farming and Field Production of Vegetables in Lelystad, one of the research stations with which we maintained close ties.'

They learned that after 25 years of experience in growing potatoes, the Research Station had observed a remarkable fact: if potatoes were grown once every three years in the test plot 'De Schreef' in Dronten, the yield was 20% lower than if they were grown there only once every six years. 'Close rotation reduces yield', as the Lelystad researchers summarized this effect,[29] which they did not believe was caused by any known potato pathogen. Perhaps the problem had to do with an accumulation of 'Deleterious Rhizobacteria',

[27] The PhD student concerned was J.W.L. van Vuurde, *Ecology of the root microflora of wheat*, PhD thesis Utrecht, 1978; interview on 10 February 2005.

[28] WJPLWCS for 1980; they are still referred to as such to this day.

[29] WJPLWCS for 1980, p. 10.

surmised Schippers. 'These DRBs are difficult to identify, since they cause damage without being pathogenic. They are a rather poorly defined group of micro-organisms.'

The PhD student F.P. Geels[30] was assigned to the project of isolating *Pseudomonas* strains from the rhizosphere of potatoes from 'De Schreef', and then testing the antagonistic power of these isolates successively *in vitro*, in pot experiments, and in the field.[31] It soon became clear from pot experiments that bacterization – treating seed-potatoes with *Pseudomonas* bacteria[32] – cancelled out the yield reduction caused by the hypothetical, unknown factor DRB and stimulated root growth. Conclusion: the *Pseudomonas* strains had an antagonistic effect on the unknown factor. In the field experiments, however, the effect was less constant – in the space of seven years, yield increased significantly three times after bacterization of seed-potatoes with WCS358.[33]

This was an interesting phenomenon: but how did the antagonistic mechanism work? It had long been suspected that the unknown factor competed with the *Pseudomonas* strains for the available iron in the soil. According to this hypothesis, the *Pseudomonas* strains emerged as the winners, causing an iron deficiency in the unknown factor that prevented it from exercising its growth-inhibiting influence. The main question that arose here, of course, was why *Pseudomonas* strains were so much more successful in obtaining iron. What were their 'weapons'? And – no trivial question – how could this be researched?

'Molecular biological techniques were ideal for this purpose', says Schippers. One of the hypotheses was that *Pseudomonas* secreted iron-binding proteins or siderophores, through which it rapidly attracted the available iron in the soil. Using molecular biological techniques, it was theoretically possible to modify *Pseudomonas* such that it lost its capacity to produce siderophores. If this mutant strain was shown in experiments to have lost its root growth promoting factor, this would prove that the battle for iron was fought with siderophores.

Together with the departments of molecular cell biology at the UU and molecular botany at the University of Leiden, Schippers submitted a project proposal on the subject 'Increasing crop yield by targeted treatment of sowing seed and seed potatoes with bacteria' to the Technology Foundation (STW),

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30 Appointed to several different temporary positions from 1978 onwards.

31 WJPLWCS for 1980, 1981, 1982, 1983.

32 WJPLWCS for 1981; F.P. Geels, *Bacterization experiments with fluorescent Pseudomonas spp. in short rotations of potato and radish*, PhD thesis Utrecht, 1988.

33 WJPLWCS for 1987, p. 10; a team led by G.J. Bollen at the Agricultural University was working on this problem too. It was eventually found that the suppression of a pathogenic fungus (*Rhizoctonia*) by nematodes was also involved.

which was approved in 1983. Each of the three applicants could appoint a PhD student to work on the new project.[34]

'The work really took off when they joined forces with the molecular biologists', says Fokkema of the rhizosphere research undertaken by his former colleague.[35] 'In the late 1980s it was among the best international work being done in the field.'

For over twelve years, the research progressed in close collaboration with Professor Peter Weisbeek of Utrecht University and Professor Ben Lugtenberg from Leiden, yielding large sums in external funding, Schippers recalls: from the Foundation for Fundamental Biological Research (BION, the biology section of the ZWO), the National Council for Agriculture Research (NRLO), the Technology Foundation (STW), and the European Union. It resulted in seven PhD theses on *Pseudomonas* and the rhizosphere at the Phytopathology Laboratory, and six each in Utrecht and Leiden.

'An added side-effect was that the research also became more closely linked to industry', remarks Schippers. 'Several of the financiers, such as the STW and the European Union, insisted on that. For years the government had been trying to reduce the vast quantities of pesticides in use. It was looking for alternatives, such as the possibility of biological crop protection and integrated agriculture, and provided incentives for related research. Our work fitted into that policy perfectly.'

'We ourselves had long been concerned about the noxious effect of pesticides', says Fokkema. *Silent Spring* had appeared in 1962. Everyone was familiar with this book, in which Rachel Carson had predicted that the day would come on which no bird would announce the coming of spring – they would be dead, having eaten worms containing accumulated DDT. That the devastating effects of pesticides were noticeably undermining the earth's ecosystem even in the remotest regions of the planet made a great impression at the time. Fokkema recalls a 1964 conference held at the Royal Tropical Institute (KIT) in Amsterdam, organized by the Biology Council of the Royal Netherlands Academy of Arts and Sciences (KNAW) – the papers given there were later published in a volume entitled *Op leven en dood* ('A matter of life or death'). He holds out a copy of the book. 'There was a large contingent from Baarn. The general mood was one of anxiety – about over-population, world food shortages. Working in the field of phytopathology put you in the middle of all that.'

34 WJPLWCS for 1983.
35 Interview with N.J. Fokkema, 7 February 2005.

After the report that DDT had even been found in the fatty tissue of penguins, the final straw came in the first report issued by the Club of Rome in 1972. If nothing were done, all fossil fuels would be exhausted within a mere thirty years. The population explosion, combined with fuel-hungry economies and the reckless squandering of air, water and soil would result in the earth being burned up, sucked dry and destroyed; it would soon be unlivable. 'Have we all gone mad?' Verhoeff quoted one reaction to the report in the daily newspaper *NRC-Handelsblad* in his inaugural address at the University of Amsterdam in 1972.[36]

The initial emphasis, wrote Fokkema in 1976 regarding the research on antagonism on the leaf surface, 'was on discovering which organisms were present and on elucidating successions which occur during the growing season.... Most of the workers were more interested in the biology of phyllosphere organisms than in specific agricultural applications involving the control of plant pathogens.... Nowadays, however, the increasing awareness of negative side-effects of fungicides on the ecosystem and the growing interest in pesticide-free agricultural products may have the result that biological control and fungicidal treatments are considered in terms of the most effective methods of disease control in relation to the ecological damage which may result.'[37]

'Look', says Fokkema, 'This is a very important picture.' He points to a photograph of a Petri dish, seen from above.[38] A dark-coloured substance has grown in the right half of the dish, completely filling it to over the halfway mark. The transition from dark to light has little inlets, like tiny fjords in a coastal region. In the light-coloured area, parallel to the 'coastal strip' of the dark section, an elongated oval is visible, like a sprayed-on island. Between the island and the coast, the colour of the Petri dish is very light, almost white. To the left of the island, the entire dish is full of little specks.

'This is the result of a classic laboratory test. What does it teach us? If we inoculate the right-hand side of a Petri dish with a pathogen (*Drechslera sorokiniana* in this case), and the left side with a saprophytic phyllosphere yeast, and then leave them to stand for about six days at 23°C, we find that

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[36] K. Verhoeff, *Fytopathologie, spel en tegenspel*, inaugural address upon accepting the position of extraordinary professor of phytopathology at the UVA (Rede uitgesproken bij de aanvaarding van het ambt van buitengewoon hoogleraar in de phytopathologie aan de UVA) on 13 March 1972.

[37] N.J. Fokkema, 'Antagonism between fungal saprophytes and pathogens on aerial plant surfaces', in C.H. Dickinson and T.F. Preece (eds.), *Microbiology of Aerial Plant Surfaces*, London, New York, Academic Press 1976, pp. 487-506, esp. p. 488.

[38] N.J. Fokkema, 'The role of saprophytic fungi in antagonism against *Drechslera sorokiniana (Helminthosporium sativum)* on agar plates and on rye leaves with pollen', *Physiological Plant Pathology* 3, 1973, pp. 195-205.

the pathogen has spread far more to the right than to the left and the saprophyte has made an island, creating a no-man's land in between. *Ergo*, the saprophyte has inhibited the pathogen's growth – it appears to be antagonistic vis-à-vis the pathogen.'

But does the antagonist also behave like this in the phyllosphere? It was known that pollen could stimulate infection by a pathogen under certain circumstances – this had been dubbed the 'pollen effect'.[39] It was also known that different phyllosphere yeasts could reduce this pollen effect. In other words, there was an antagonistic relationship between the phyllosphere yeasts and the pathogen in the presence of pollen.

'So what emerged from all this?' Fokkema continues, rhetorically. He points to the publication with the picture of the Petri dish, over thirty years old by now. There are leaf-dwellers, such as *Cladosporium* and white yeasts, which do not exhibit any antagonistic behaviour in a Petri dish. But if those saprophytes encounter the same pathogen in the presence of pollen on rye leaf, they can halve the degree of infection by that pathogen. Then they suddenly *do* behave antagonistically. The difference between a strong and a weak antagonistic saprophyte (as defined *in vitro*) may vanish altogether in the natural environment. One that is not antagonistic on agar may be so on a rye leaf. To put it more simply, the laboratory test is not indicative of what will happen in the field. 'So, when studying antagonism, the use of pure cultures on agar plates can be misleading', Fokkema had concluded his presentation on the subject at the time.[40]

'Take another good look at the picture', he says. 'To the left of the island, the dish is covered with specks. The pathogen is developing there again. That would not be possible if the production of antibiotic were the antagonistic mechanism. In that case, we would see a white ring all around the antagonist. Probably the inhibition mechanism is different on agar – that is, *in vitro* – than it is *in vivo*. Probably the so-called inhibition zone *in vitro* is caused by inhibitive substances that the pathogen secretes itself – and not by antibiotic from the antagonist. And the antagonistic effect in the field is probably a consequence of competition for food – in this case pollen.'

So naturally occurring microflora in the phyllosphere had antagonistic properties. This was most striking in the case of a peak in the food supply – pollen or honeydew – at which times it would act as a buffer; it substantially

[39] When rye leaves were inoculated with a pathogen just after flowering (i.e. after the dissemination of pollen) the degree of infection by that pathogen was higher than if inoculation had taken place before flowering. Ibid., p. 195.

[40] Ibid., p. 204.

reduced the likelihood of pathogens leading to infection. 'Now what interested me most was that the food competition hypothesis made it fairly predictable which group of pathogens could be inhibited by the yeasts and which could not', says Fokkema. Pathogens that normally penetrate the leaf almost immediately will be far less sensitive to food competition and therefore far less inhibited by the phyllosphere flora that are present.[41] But pathogens that depend on the presence of nutrients in the phyllosphere if they are to penetrate the leaf will be adversely affected by the mechanism of food competition, and will therefore be affected antagonistically by the phyllosphere flora.[42] 'The arrival of expensive climate cabinets was particularly crucial to our research', says Fokkema. 'They made it possible to measure, very accurately, the effects of temperature, relative humidity, the availability of water, and nutrients on the yeasts in the phyllosphere of wheat.[43] We got a lot of mileage out of those climate cabinets.'

That the yeasts had a favourable (i.e. antagonistic) effect on the infection caused by a large number of pathogens had been proven – but could they also have an adverse effect on the plant? Some claimed that the phyllosphere flora extracted nutrients from the leaf when no exogenous food was available, accelerating the senescence of the leaf. 'The alleged noxiousness of phyllosphere yeasts was a "hot item" at several phyllosphere conferences', Fokkema recalls. 'We conducted extensive research into it, but found no evidence for it whatsoever.'[44]

The knowledge that the phyllosphere flora possessed significant antagonistic properties led to two important hypotheses. First: the effects of fungicides might well be far more devastating than had always been assumed. For if they destroyed naturally occurring mycoflora as well as the targeted pathogens, a single spraying might eliminate a major source of natural protection. And secondly, stimulating the normal phyllosphere flora might perhaps be introduced as a form of biological pest control.

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[41] This applies most notably to biotrophic pathogens such as rusts and mildew. The visiting scientist M.A. Williamson later found that a necrotrophic pathogen that penetrates directly is also inhibited by yeasts.

[42] N.J. Fokkema, 'Antagonisme tussen saprofytische en pathogene schimmels van het blad', *Gewasbescherming* no. 6, 1975, pp. 131-139.

[43] See also Bashi, E. (visiting scientist) and Fokkema, N.J., 'Environmental factors limiting growth of *Sporobolomyces roseus*, an antagonist of *Cochliobolus sativus*, on wheat', *Transactions of the British Mycological Society* 68, 1977, pp. 17-25.

[44] N.J. Fokkema, P. Kastelein and B.J. Post, 'No evidence for acceleration of leaf senescence by phyllosphere saprophytes of wheat', *Transactions of the British Mycological Society* 72, 1979, pp. 312-315.

Both these hypotheses were investigated in Baarn. The first one proved to be correct. A fungus, relatively insensitive to the pesticide benomyl, could damage on average 40 % more of the leaf surface after the plant had been sprayed with benomyl than after it had been sprayed with water. The spraying had greatly depleted the natural mycoflora and hence its antagonistic properties as well.[45] Further research into the effects of these naturally occurring yeasts in field conditions showed that they were able to prevent the accumulation of nutrients on wheat leaves.[46] This reduced the direct damage caused by deposits of honeydew, originating from aphids, and consequently the stimulation of pathogens. Using computer simulation, it proved possible to predict this 'clearing-up capacity' of the yeasts in different conditions. 'If the development of the natural yeast population is not disrupted, the use of insecticides and fungicides can be reduced', was the conclusion of this project – the last of the phyllosphere research projects carried out in Baarn.

The second hypothesis also proved to be correct, but using it as a form of biological control proved to be far more complicated than it had seemed. 'You have high-pitched expectations', says Fokkema. 'And there comes a point when you want to do too much at once, and then nothing will work. It was a wonderful idea, of course: if you could strengthen that natural buffer to the stage that it would also work preventively, it would be fantastic.' The principle did turn out to be largely effective: when the researchers sprayed wheat with a cocktail of permanent leaf-dwellers and their nutrients, and then tried to infect the crop artificially two weeks later, this wheat proved less susceptible to infection than untreated wheat.[47]

But if, in the latter case, the phyllosphere had become just as densely populated, through natural causes, as on the treated wheat, the difference evaporated. This meant that the preventive effect lasted only for two weeks. 'A natural yeast population that has almost been washed off the leaf by a heavy rainshower will recover just as rapidly', says Fokkema. 'In practice it was not an effective mode of pest control, quite aside from all kinds of mundane considerations like: When should preventive spraying be carried out? How much do

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45 N.J. Fokkema, J.A.J. van de Laar, A. Nelis-Blomberg, B. Schippers, 'The buffering capacity of the natural mycoflora of rye leaves to infection by *Cochliobolus sativus*, and its susceptibility to benomyl', *Netherlands Journal of Plant Pathology*, 81, 1975, pp. 176-186.

46 A.J. Dik, *Population dynamics of phyllosphere yeasts: influence of yeasts on aphid damage, diseases and fungicide activity in wheat*, PhD thesis Utrecht, 1990 (BION research project, in collaboration with Professor R. Rabbinge, department of theoretical production ecology, Agricultural University, Wageningen).

47 N.J. Fokkema, J.G. den Houter, Y.J.C. Kosterman, A.L. Nelis, 'Manipulation of yeasts on field-grown wheat leaves and their antagonistic effect on *Cochliobolus sativus* and *Septoria nodorum*', *Transactions of the British Mycological Society*, 72, 1979, pp. 19 -29.

you use? How often should it be done?' He looks out of the window and grins. 'You don't even know if the crop would have become diseased at all.'

Physiologically-oriented phytopathological research

'Our project team carried on where the one led by Schippers and Fokkema stopped', says Verhoeff. 'They described and studied the interactions between micro-organisms on the leaf and around the root – the processes that play a role before the pathogen infects the plant. We looked at what happens if the pathogen actually penetrates the plant: what weapons does it have? And how does the plant defend itself?'

Attack and defence are two processes that are very difficult to distinguish. Generally only the result is visible: either the plant becomes diseased or it does not. The entire chain of action and reaction leading up to this end result can only be studied effectively with the aid of sophisticated model systems. Each system must be designed to answer a specific question. As Verhoeff explains, 'The objective of the research is to gain a deeper understanding of the factors that help to determine the resistance and susceptibility of plants to pathogenic micro-organisms, in particular so-called opportunistic parasitic fungi. The primary topics studied are: fungitoxic compounds (phytoalexins) produced by the plant in response to pathogens, toxins and cell-wall degrading enzymes produced by pathogens, and lignification and tylose formation induced by pathogens. All these topics are studied with the use of different host-pathogen combinations, accenting specific topics with each combination.'[48]

This team consisted of three permanent researchers, each of whom had developed a particular specialism. For instance, Verhoeff himself led the research on the formation and action of 'a whole battery' of cell-wall degrading enzymes ('the attack'), while the induction of phytoalexins and their metabolism ('the defence') became the province of Joop van den Heuvel, with Doekle Elgersma leading the research into the resistance mechanisms of elm and tomato.

'The research done by the ecological team was inherently more descriptive', says Verhoeff. 'What we were doing was purely experimental.' That also translated itself into instrumental requirements. For the ecological team, for instance, environmentally controlled experimental conditions were indispensable; these researchers had the greatest need of climate cabinets and chambers. For the physiological team, on the other hand, the main need was for technologically advanced separation equipment – chromatographs and centrifuges.

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[48] WJPLWCS for 1978.

‘Of course everyone used the instruments that were available in the Laboratory’, adds Verhoeff. ‘It was not the case that one team had certain apparatus that another team was unable or forbidden to use. But there was a difference of emphasis.’ Both teams were also basically engaged in experimental research: it is not true that ecological research is only descriptive, for instance, any more than it would be true to say that physiologists never do descriptive research. The difference was one of scale, and most importantly of time.

This was reflected in publication size and frequency. ‘Research of a more descriptive nature is always more time-consuming, while experimental work is more concise’ explains Verhoeff. ‘This meant that our publications tended to be much shorter, but more frequent.’

Take Van den Heuvel’s work, for instance: after winding up his phyllosphere research – which culminated in a PhD thesis produced under the supervision of Kerling on 7 December 1970[49] – he specialized in the exceedingly refined, precise and detailed biochemical research on the formation and function of phytoalexins, fungitoxic substances naturally produced by plants. At that time these were seen in the entire international phytopathological community as the key to plants’ resistance mechanisms. For in a healthy plant, no phytoalexins were measurably present, but as soon as a plant was infected, their concentration could suddenly increase. But what did they do, exactly? How were they formed? What was their relationship to other substances? And what is more, how could they be isolated and studied?

Van den Heuvel initially concentrated on the infection process of a number of different isolates from the common fungus *Botrytis cinerea* on French beans as host plant. The isolates induced different reactions – from spreading lesions in one case to small ones in another. In reaction to the infection, the bean produced the phytoalexin phaseolline.[50] Was this phaseolline concentration sufficient to halt the infection? Were highly pathogenic isolates capable of detoxifying the phytoalexin? They seemed to be: smaller concentrations of phytoalexin were found around spreading lesions than around small ones – and virulent pathogens proved better able to detoxify the phytoalexin. Further study revealed, however, that these facts were not causally related.[51]

Since the phytoalexins did not resolve the question of the plant’s defence mechanism, Van den Heuvel turned his attention to the infective capacity of

[49] J. van den Heuvel, *Antagonistic effects of epiphytic micro-organisms on infection of dwarf bean leaves by Alternaria zinniae*, PhD thesis Utrecht, 1970.
[50] J. van den Heuvel, D. Grootveld, ‘Phytoalexin production in French bean leaves infected by *Botrytis cinerea*’, *Netherlands Journal of Plant Pathology,* 84, 1978, pp. 37-46.
[51] WJPLWCS 1974-1979.

Botrytis. What substances could stimulate infection? Were these substances already present in the incipient lesions and in necrotic leaf tissue? And what cell wall degrading enzymes played a role in infection?[52] Cell wall degrading polygalaturonases were possibly involved in causing damage,[53] wrote Van den Heuvel, and in reaction to this, the leaf perhaps mobilized its own natural inhibitors; but the exact link between these events remained unclear.

A great many meticulous experiments generated a wealth of correlations, conversion reactions, and hunches: but the precise role of the phytoalexins in the plant's defences remained obscure. 'The same applied to some extent to my own research', says Verhoeff, looking back. 'There were no clear answers.' How does a fungus succeed in penetrating the plant's surface? 'With the benefit of hindsight, perhaps you have to say that we were working with the wrong models.'

In Verhoeff's research too, *Botrytis cinerea* was the most important pathogen, and he too focused on the role of different substances in the penetration process. Spores of *Botrytis* secreted cell wall degrading enzymes – but the influence of external conditions on this secretion remained obscure.[54] Electron and light microscopic images produced a fascinating picture of the penetration by *Botrytis* in a young tomato plant – but how representative were they?[55] To what extent was it possible, using immunological techniques, to analyse the role of enzymes that were crucial to breaking down the first barrier, the waxy cutin of the tomato fruit and the petals of Gerbera?[56]

If *Botrytis* had infected the fruit of a tomato plant, this fruit would exhibit small necrotic patches known as 'ghost spots'. Healthy cells surrounding the invading pathogen evidently died off, thus preventing it from spreading any further into the plant. A similar, highly effective encapsulation of the pathogen had also been observed in other plant-pathogen combinations. It was one of the mechanisms used to explain the difference between a resistant and a non-resistant plant. But exactly how did this process work? What role did the

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[52] WJPLWCS 1978-1988.

[53] G. Leone, E.A.M. Schoffelmeer, J. van den Heuvel, 'Purification and characterization of a constitutive polygalacturonase associated with the infection process of French bean leaves by *Botrytis cinerea*', *Canadian Journal of Botany* 68, 1990, pp. 1921-1930.

[54] K. Verhoeff and J.I. Liem, 'Presence of endo-polygalacturonase in conidia of *Botrytis cinerea* before and during germination', *Phytopathologische Zeitung* 91, 1978, pp. 110-115.

[55] F.H.J. Rijkenberg (visiting scientist), G.T.N. de Leeuw and K. Verhoeff, 'Light and electron microscopic studies on the infection of tomato fruits by *Botrytis cinerea', Canadian Journal of Botany* 58, 1980, pp. 1394-1404.

[56] J. Salinas Calvete, *Function of cutinolytic enzymes and the infection of gerbera flowers by Botrytis cinerea*. PhD thesis Utrecht, 1992.

Student excursion to the province of South Holland, June 1973. Reproduced by courtesy of Koen Verhoeff.

various enzymes play in it? 'The crucial questions concerning the role of callose, suberin and scopoletin in disease resistance remain unanswered' was one of the conclusions presented by the team in 1985.[57]

'Resistance mechanisms are highly complex', says Doekle Elgersma.[58] 'Attack and defence are one whole. Why are some elms resistant to elm disease and not others? And what happened in the 1970s, when a highly aggressive variant of *Ophiostoma ulmi*, the fungus that causes elm disease, blew over from England? Even our resistant trees could not withstand it. So what exactly is the resistance mechanism?'

Elgersma too succeeded in demonstrating a number of differences and correlations. After infection with *Ceratocystis ulmi*, an elm was shown to rapidly produce the mansonones E and F (specific phytoalexins) – but these

[57] G.T.N. de Leeuw, 'Deposition of lignin, suberin and callose in relation to the restriction of infection by *Botrytis cinerea* in ghost spots of tomato fruits', *Phytopathologische Zeitung* 112, 1985, pp. 143-152, p. 151; see also J.A. Glazener, *Defence mechanisms of tomato fruits after infection by Botrytis cinerea*, PhD thesis Utrecht, 1980.

[58] Interview, 24 February 2005.

substances themselves could not be held responsible for the tree's resistance to elm disease,[59] since susceptible trees displayed precisely the same behaviour.

The same applied to the formation of tyloses after infection, another defensive reaction. Both susceptible and resistant trees formed tyloses, as a result of which the vessels became clogged and the fungus could not spread so easily through the tree – but it did not matter in this regard whether the trees had become infected with a harmless pathogen or with a highly aggressive variant of *Ophiostoma ulmi*. In general, resistant trees did react more rapidly.[60]

Then there was an anatomical difference between resistant and susceptible trees. Statistically speaking, resistant elms had slightly shorter and narrower vessels than a susceptible tree; but only minute inspection showed this up; nor did it explain much. 'There is no single mechanism underlying resistance', says Elgersma. 'It may be caused by a whole complex of interactions. And with an elm, that is a very hard thing to research.'

'In retrospect, you have to say that everyone was completely in the dark at that time', says Professor Kees van Loon, the present professor of phytopathology at Utrecht University. 'In retrospect, you have to say that the physiological questions they were trying to answer could not be resolved with the available techniques. Not until molecular biological methods were introduced did that become possible; they simply didn't exist then.' It was as if you were trying to understand the rules of soccer by looking only at what happens in the penalty area.

'It is only now', says Van Loon, 'that we know roughly how that incredibly complex chain of actions and reactions, which take place at molecular level throughout the plant, fits together.' He swings one arm demonstratively. 'An infection signal is recognized here.' Then he swings the other arm in the opposite direction. 'And here a protein is synthesized.' He jabs a finger forwards: 'and here are small necrotic patches. All sorts of things are going on here: cell walls are thickening or necrotizing, the pathogen is hemmed in. But if you only look at this, you miss the connections with what is happening elsewhere.' He folds his hands. 'The plant was a "black box" in those days. There were simply no ways of taking a good look inside it.'

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[59] J.C. Overeem and D.M. Elgersma, 'Accumulation of mansonones E and F in *Ulmus Hollandica* infected with *Ceratocystis ulmi*', *Phytochemistry* 9, 1970, pp. 1949-1952; D.M. Elgersma and J. Overeem, 'The relation of mansonones to resistance against Dutch elm disease and their accumulation, as induced by several agents', *Netherlands Journal of Plant Pathology* 77, 1971, pp. 168-174.

[60] D.M. Elgersma and H.J. Miller, 'Tylose formation in elms after inoculation with an agressive or a non-aggressive strain of *Ophiostoma ulmi* or with a non-pathogen to elms', *Netherlands Journal of Plant Pathology* 83, 1977, pp. 241-243.

But that was no reason to sit back and do nothing. The elm researchers also tried to find biological ways of controlling elm disease, with financial support from the European Union and the National Forest Service (Staatsbosbeheer). In the early 1980s, Schippers' team had discovered that *Pseudomonas* strains had an antagonistic effect in potatoes. 'So what about elms?' was the question that was immediately raised by the team studying resistance mechanisms in vascular parasitism. 'We were not thinking about the siderophores', explains Elgersma. 'They were not relevant to elms. What interested us was the general idea of bacteria having an antagonistic effect on fungi. Perhaps that might prove useful.'

The PhD student Ruud Scheffer adopted a classical approach. He started by testing *in vitro* the antagonism between a number of *Pseudomonas* strains and *Ophiostoma ulmi*. Then he injected various strains into healthy trees. The results were astonishing. The laboratory tests had little predictive value for the tests *in vivo* – Fokkema had reached the same conclusion. In the Petri dishes, each of the bacteria exhibited its own individual behaviour. One was markedly antagonistic, while another seemed to have little effect. But once injected into the elms, there was little perceptible difference between them. 'Again the question can be raised [of] whether *in vitro* antagonism provides a reliable selection tool', Scheffer declared.[61]

Far more important was what the bacteria did to the elms. If healthy trees were inoculated with *Ophiopstoma*, they would at length exhibit severe symptoms of elm disease: *ergo*, it was *Ophiostoma* that caused the disease. If they were treated with bacteria, they stayed healthy for at least two growth seasons; in other words, the bacteria did not generate any diseases. If trees were inoculated first with *Ophiostoma*, and then with bacteria, they became and remained diseased; bacteria had no curative influence. But if healthy trees were inoculated with bacteria *before* the contact with *Ophiostoma*, they did not exhibit any symptoms. The conclusion was clear: the bacteria treatment had a preventive influence.[62]

This touched on the recent discovery of a different phenomenon. For other plant-pathogen combinations it had already been shown in other parts of the world that by introducing a substance extraneous to the plant, you could induce a general resistance that proved effective against pathogens. 'Induction or enhancement of resistance in elm is probably of vital importance for the success of (biological) control of Dutch elm disease', wrote Scheffer in 1984.

[61] R.J. Scheffer, *Dutch Elm Disease: Aspects of pathogenesis and control*, PhD thesis Amsterdam, 1984, p. 68.
[62] Ibid., p. 55.

Exactly how it worked was a mystery, as was how long it worked, and whether it would work with all elm varieties. But for the first time in the long history of elm research, a real possibility was emerging of the biological control of elm disease. And the new method – along with the sawing down of diseased trees (often too late) and developing resistant elms (time-consuming) – promised to be not only more efficient, but also to excel in terms of elegance, sustainability and simplicity.

Virologically-oriented phytopathological research

'Three was too many', says Hendrien Wieringa-Brants, looking back.[63] 'With a professor heading each of the project teams, the Laboratory became top-heavy.'

In 1980 all senior lecturers (*lectoren*) had automatically become professors. This included Schippers, who had been a senior lecturer at Utrecht University since 1972, and Wieringa-Brants, senior lecturer at the University of Amsterdam since 1963. And Verhoeff had been a professor at both universities since 1970. 'Just think about it', says Wieringa-Brants, 'three professors out of a total of nine researchers with permanent contracts. That was out of all proportion.' From then, she says with hindsight, it was clear that her own project team, virological phytopathological research, would not survive.

She immediately corrects herself. Actually, she says, the threat had been hanging over them for far longer. As soon as Verhoeff had taken over as director from Kerling, the pressure from the universities had increased tangibly. He could not do anything about that himself; it arose from all sorts of external factors.

In 1970 the University Administration (Reform) Act (*Wet Universitaire Bestuurshervorming*; WUB) had entered into force, and quite soon after that, the first round of reorganizations – 'basically cutbacks' – began. 'The atmosphere at the lab changed completely in that period', says Wieringa-Brants. 'Everything had to be efficient and measured. Twenty minutes' coffee break and then quickly back to work. At one point they even installed a time clock. And then that endless economy drive.' She slowly shakes her head. 'It just never stopped.'

The University Administration (Reform) Act had led initially to a sweeping democratization of the fossilized university structures. All academic staff with permanent contracts automatically became members of an institutional council, which gave them a say in the university's policy, its budget, and all sorts of

[63] Interview with D.H. Wieringa-Brants, 10 March 2005.

Three in academic gowns. From left to right: Bob Schippers, Hendrien Wieringa-Brants, (beadle), Koen Verhoeff. Reproduced by courtesy of Bob Schippers.

internal matters. 'It gave you an opportunity to speak out, even if you were not a senior lecturer or professor', says Fokkema. 'I really appreciated that.' The other side of the coin, however, was that the new Act introduced a culture of meetings within the biology subfaculties of the three universities that soon expanded into a jumble of committees, a culture that did not leave the staff of the Phytopathology Laboratory in Baarn untouched.

The annual reports tell the story of a staggering number of committees being formed within the space of a few years to help administer the universities. Besides a Sub-Faculty Council, Budgetary Committee and Science Policy Committee, each university soon had its own Education Committee, Scheduling Committee, Personnel Committee, Waste Products Committee, Reallocation Committee, Structural Planning Committee and Garden Council, all created in the early 1970s.

Besides these internal bodies, there was the regular work in external committees and boards: trade unions, councils, consultative structures, journals and conferences – not to mention incidental steering committees, platforms and coordinating committees. Emulating the chemists, physicists and mathematicians, the biologists too finally founded their own organization in 1970, the Foundation for Fundamental Biological Research (BION), a branch of ZWO, which had been established back in 1950. And not long afterwards, the first specialist branches of biology formed separate study groups within BION. These were logical and necessary reactions to government initiatives seeking to introduce a centrally coordinated science policy.

'For a long time, the government had left scientists to do that themselves', says Dr Peter Baggen, senior policy officer of the Advisory Council for Science and Technology Policy in The Hague.[64] 'Take ZWO, the Netherlands Organization for the Advancement of Pure Research, which was set up just after the Second World War. That was typically an organization created by and for scientists: all the government did was to set its budget. Allocation was a matter for the scientists, who developed their own criteria and supervised the procedures themselves. That was thought to be the best way to catch up the ground the Netherlands had lost in the war. It worked, you can say retrospectively.' But perhaps it actually worked too well.

Research became the norm. Research had long been linked to teaching, both financially and ideologically. This link was part of the heritage of the previous Higher Education Act (*Hoger-Onderwijswet*), dating from 1876. Students had to be trained by, and trained to become, qualified researchers – the university's task was no longer confined to preparing young people from the well-to-do classes for a life of scholarship; it was also expected to turn out competent researchers with independent minds. So budgets were based on the number of students. And so it remained in the successor to the 1876 Act, the 1960 University Education Act (*Wet op het Wetenschappelijk Onderwijs*). 'But if you extrapolated the figures', says Baggen, 'it became clear, as far back as the late 1960s, that if the policy was not changed, higher education would soon end up consuming the entire national budget. No one had predicted such an explosive increase in student numbers. Something had to be done. It was getting completely out of hand.'

The Dutch government did not pursue any science policy at all, in terms of planning, objectives, resources, or evaluation, concluded the Organisation for Economic Cooperation and Development (OECD) in 1963. The government's Advisory Council for Science Policy (precursor of the current Advisory Council for Science and Technology Policy), launched especially to remedy this problem in 1966, almost immediately defined the key terms that would dominate the debate on science policy for decades to come: quality, concentration, and relevance to society. In the first Policy Document on Science Policy, published in 1974, by the first science policy minister (without portfolio), Boy Trip, and his state secretary Dr Ger Klein – both members of the progressive

[64] Interview with P. Baggen, 24 January 2005.

government of strong men led by Joop den Uyl – there were three central issues: the quality of research, the efficiency of research, and attuning research to the needs of society.

These were golden days for administrators and graduates with administrative aspirations. Brand-new sector councils, such as the National Council for Agriculture Research (NRLO), were mandated to focus on quality and relevance to society. That was another novelty: academics and administrators putting their heads together to scrutinize the science sector, guided by the monotonous mantra: 'better, more efficient, more relevant'. Like cutting into their own flesh, accused their opponents. Out-and-out treachery.

More policy documents on science policy soon followed. The two issued by the Ministries of Education, Arts and Sciences and Economic Affairs – the Policy Document on University Research, and the Policy Document on Innovation, both issued in 1979 – described once again why and how control should be exercised (demand-driven in economic terms, partly by means of the Technology Foundation STW, which had been especially founded for that purpose), and who in particular would design and monitor quality criteria (review committees, using the instrument of conditional funding). They also stipulated that scientific research could only expand in future through contract research, either through indirect funding mechanisms such as ZWO, BION, and NRLO or in cooperation with industry. Direct funding (i.e. directly from the government to universities) was assigned to the 'nil norm', which was jargon for no growth. Cutting costs would be the ultimate result.

In the early 1980s, the Christian Democrat education minister Wim Deetman finally had the honour of implementing all the policy proposals drafted in different variants by his predecessors, which he did implacably. The titles of the policy documents became more specific. For anyone who had not yet got the point, the changes were now defined in military terms as the Subject Specialization and Concentration Operation (TVC, 1984) and the Selective Shrinkage and Growth Operation (SKG, 1987). Wherever research was being duplicated, there must either be a shift of accent or the teams performing less well would be disbanded. Only the best would be allowed to survive; science had become a rat race, or so it sounded to many scientists' ears. The scientific climate had never been so harsh: the rule of 'publish or perish' had set in.

'Eventually Deetman wanted to give the universities more autonomy', says Baggen. 'He pursued a two-phase policy: restructuring academic education on the one hand, and giving more autonomy on the other. The successful completion of the first phase, which he called 'bringing [the universities] up to date', was a condition for introducing the second phase – "and now you can stand on your own two feet."'

‘I had come to Baarn because I missed teaching, and wanted to do more of my own research’, says Verhoeff. ‘I wanted to have *less* management to worry about, not *more*. Looking back, I have to say that I scarcely got around to doing any research. My time was soon almost completely taken up with administrative responsibilities.’

All the permanent staff of the Phytopathology Laboratory took some part in the democratic decision-making at the universities. Differences existed, of course: not all universities encouraged active participation to the same extent, and some individuals joined in with more gusto – and more flair – than others. Even so, structural changes gradually made themselves felt. From the early 1970s onwards, the Baarn phytopathologists periodically cancelled their usual daily journey to the Villa, travelling instead to Amsterdam or Utrecht (depending on their appointment) to huddle in smoke-filled meeting rooms, debating and voting about issues ranging from the quality of research, the relevance of specific funding models, the allocation or reallocation of additional resources and the nature and number of experimental animals at the subfaculty to the coffee allowance and the locations of photocopying machines, together with fellow biologists specializing in fields the Baarn representatives only dimly recalled from their university days.

Baarn lay in between the universities, both literally and figuratively. And the Laboratory was still fairly small. This meant that in an administrative sense, it resembled a satellite that could effortlessly negotiate roller coasters around the different universities – never too close, never in an exclusive trajectory around a single centre, never colliding with others. The professor-director of this Baarn Laboratory was almost fated to take the lead in the frequently upsetting but necessary restructuring operations in university biology. ‘Verhoeff occupied a special position’, explains Professor Jan Carel Zadoks, professor emeritus of phytopathology at the Agricultural University. ‘As director of the Phytopathology Laboratory, he stood to some extent outside the university’s everyday routine. He was not a threatening figure; his position gave him a sort of built-in distance. He was a capable biologist – besides which he had a tremendous gift for administration, of course. Phenomenal. That was not always rewarding work – far from it; some financial cuts were really harsh – but the way in which he managed to put Dutch biology’s house in order was absolutely fantastic.’

‘I had a seat on the University of Amsterdam’s biology sub-faculty council when the university decided to push through a reorganization in 1973’, says Verhoeff. ‘My God, what a load of waffle was talked back then.’ He took the lead on the sub-faculty council, and continued doing so at successive levels, right up to that of national science policy. He became chair of the UVA’s faculty council, of BION, the Biology Council, and the Netherlands Institute of Biology (NIBI). 'Verhoeff was a powerful man', says Hendrien Wieringa-Brants. 'At one point he occupied almost all the key positions.'

'In the early 1970s, when the flow of money was virtually cut off, biology looked to the outside world like a chaotic field, with people who only shouted their opposition to anything that might harm the natural world without doing anything to help solve the problems', says Verhoeff in an interview held around the time that he stepped down as director of the Willie Commelin Scholten Phytopathology Laboratory in 1987.[65] He had seized the opportunity to set up what he dubbed the National Working Group on Biology ('Open Beraad') together with the chairman of the Biology Council. In other words, 'Open Beraad' was an initiative launched by the biologists themselves – in contrast to the Biology Fact-Finding Committee (*Verkenningscommissie Biologie*) later set up by the science minister.

'Open Beraad' had already screened and assessed the fundamental research being done in biology at universities and the KNAW institutes, with the Biology Council and BION playing a leading role. Its final assessment was published in 1979. 'I think that the "Open Beraad" report was traumatic', says Verhoeff. 'I did realize, afterwards, that it certainly must have been a big shock for many research teams that had not been directly involved in the 'Open Beraad' discussions to suddenly read in a little book what a number of people thought of their research organization or research output.'[66]

'The report contains assessments of research, based on a single criterion', wrote the authors in the final report of the 'Open Beraad' in 1979: 'namely, the quality of the research, as measured by the productivity of the research teams, both qualitatively and quantitatively speaking.... The assessment was based on the following:

a) Research output, as quantified by:
   - The nature and content of publications;
   - The number of publications;
   - The nature of the magazine in which it was published, with particular regard to its international standing.

b) The team's national and international standing, based on conference papers, numbers of visiting scientists, and contributions to books and general articles in the team's field.'[67] The 'Open Beraad' gave its verdict in a score expressed in

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65 'Interview met prof.dr. K. Verhoeff', *Vakblad voor Biologen* 67, 1987, pp. 101-102.

66 Ibid., pp. 101-102.

67 'Biologisch Onderzoek in de Subfaculteiten Biologie en Instituten voor Fundamenteel Biologisch Onderzoek', Report of the working group 'Open Beraad voor het Biologisch Onderzoek', 1979, pp. 29-30.

numbers of 'balls', three balls being 'good to very good', two being 'reasonable to good' and one being 'mediocre'.

Page 56 of the report contains the verdicts on the research teams at the Phytopathology Laboratory. The teams headed by Verhoeff (mechanisms of resistance and susceptibility) and Schippers (ecology of pathogenic and saprophytic micro-organisms) have three balls each, while Wieringa-Brants's team (resistance mechanisms of plants against viral infections) has only one. The brief explanatory note reads: 'The team entitled 'resistance mechanisms of plants against viral infections' studies hypersensitive reactions as a form of resistance. This team's research recently underwent a shift of orientation, the results of which have yet to be seen.'[68]

Wieringa-Brants's team originally consisted of two permanent researchers besides herself: Emma Weststeijn (from 1971 onwards) and Dr Gerard de Leeuw. Until the 'shift of orientation' noted in the 'Open Beraad', each of the three team members had been engaged in independent projects: Wieringa-Brants was working only half days at that time, and most of her time was taken up by teaching plant virology, Emma Weststeijn was preparing a PhD thesis on the role of the enzyme peroxidase in the necrotizing reaction of a plant to a viral infection, and De Leeuw was specializing in research on mycoplasms.

'Mycoplasms are naked bacteria', he explains. 'They are surrounded by a membrane, but have no fixed cell wall. This makes it possible for them to pass through a bacterial filter.' In 1967, Japanese researchers had found mycoplasms in the sieve-tubes of mulberry trees with lethal yellowing disease. That was something new: mycoplasms were known as pathogens in the medical and veterinary world, but not yet in plants. A large number of plant diseases hitherto ascribed to viruses now turned out to have been caused by mycoplasms. 'I found that interesting, and was eager to research it. Koen Verhoeff gave his approval, and so I started specializing in mycoplasms.'[69]

In 1975, Wieringa-Brants writes in her annual report, 'all projects were reviewed critically to see how the research programmes could be made more cohesive in the future.'[70] In 1976 that led to the decision to continue two lines of research, namely 'aspects of hypersensitivity after inoculation with tobacco mosaic virus as occurring in certain tobacco varieties, and the reproduction of the virus in plants with differing sensitivities to it. This last aspect to be studied with the combination of tobacco necrosis virus (TNV)

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[68] Ibid., p. 57.

[69] Interview with G.T.N. de Leeuw, 2 February 2006; see also G.T.N. de Leeuw, 'Mycoplasma's in planten', *Natuur en Techniek* 45, 1977, pp. 74-89.

[70] WJPLWCS for 1975, p. 15.

and French bean.'[71] There was no room left for De Leeuw's research on mycoplasms in this new set-up. He left the virology team and joined Verhoeff's project group, where his histological expertise would be used to better advantage.

'I had a fine collection of mycoplasms', he says. 'But my research did not fit into the new structure. What is more: mycoplasm diseases occur primarily in the tropics and not in economically important crops in the Netherlands. And applying for development aid grants to control disease in tropical crops was not part of the team's general policy.' His collection was handed over to fellow scientists from Bonn and Dijon.[72]

All that remained was the research on hypersensitive reactions. That was a very well-known resistance phenomenon, but its mechanism was completely obscure. In some cases necrotic lesions arose in reaction to infection by a virus,[73] greatly limiting the expansion and reproduction of the virus in the plant. But how did that process work? How did the necrosis of those cells help to restrict the spread of the virus? Was there a necrosis-inducing factor? What was the influence of temperature? What enzymes played a role? On 16 June 1982, Weststeijn was awarded her PhD, on the strength of a thesis on aspects of the hypersensitive reaction.[74] In 1984 she transferred to Schippers' team.[75] By then, the decision to disband the team had already been taken.

'The problem with this research on the physiology of plants with viral disease', says Van Loon, 'was that no one understood how a virus could induce a plant to develop symptoms of disease or resistance. Molecular biological techniques did not yet exist. What is more, very few people were doing this type of research. Most plant virologists only studied the virus, or described symptoms of viral diseases. The number of people who incorporated the plant's physiology into their research could be counted on the fingers of one hand, even internationally.'[76] He grins. 'In fact the teams led by Wieringa-Brants and Verhoeff were really doing very similar research … But neither of them could see that.'

71 WJPLWCS for 1976, p. 15.

72 In 1998, De Leeuw was awarded a distinction for his work on mycoplasms by the International Organization Mycoplasmology in Sydney.

73 Necrotic lesions are dark patches consisting of a small group of dead cells.

74 E.A. Weststeijn, *Aspecten van de hypersensitieve reactie van Nicotiana tabacum cv. Xanthi nc. na infectie met tabaksmozaïekvirus*. PhD thesis Amsterdam, 1982.

75 WJPLWCS for 1984 and following years.

76 Interview with L.C. van Loon, 10 March 2005.

From 1978 onwards, the biology subfaculty of the University of Amsterdam was constantly restructuring and reorganizing its research and teaching. All the cutbacks, wrote the subfaculty to the board of the mathematics and physics faculty on 17 June 1983, were now laid down in a Total Plan for 1983-1988. With a view to the objectives of the Biology Fact-Finding Committee (the drafting of a total plan for biological research, leading to a decline in personnel costs averaging 20% in 1986 for all research, the distribution of which was to be coordinated by a Subject Specialization Committee (*Taakverdelingscommissie*)), it had decided to disband the research team 'resistance mechanisms of plants against viral infections'.[77]

The full text reads as follows: 'following the proposal of the Steering Committee on the Restructuring of Biology, the prior condition set for this reorganization (reducing to two the number of research teams) has led the sub-faculty council to decide to disband the team "resistance mechanisms of plants against viral infections" on the following grounds:

– The low/negative assessment of this research team by the science committees of the UVA and the UU;
– The UU subfaculty's view that the said research team should be terminated (UU reorganization plan);
– The UVA faculty's rule on the size of research teams.

In consultation with the steering committee, it has been decided not to retain the position of professor on the following grounds:

– The present structure of the department is far too top-heavy (3.0 professors; 5.0 permanent members of staff);
– After the said research team is disbanded, the virological research will not be continued in another team within the department;
– Only the basic teaching on virology will need to be continued on a limited scale. This can be done under the responsibility of the phytopathology professorship within the department.'

And that was the final word on the matter.

In the event, almost five years would elapse between the notification of this decision and Wieringa-Brants's forced resignation on 1 January 1988. 'Draining', she says, looking back. 'Since the threat of closure had been hanging over my team for years, fewer and fewer students came to study subjects with me, the guest researcher who worked with us for a while decided to transfer to a different team, I was not assigned any technical assistance any more, and eventually there you are, facing it all alone. No wonder you publish less.' Then

77 Biology subfaculty to board of FWN, UVA, 17 June 1983, GAA 1020, inv. 602: 'stukken betreffende TVC in verband met samenwerkingen en opheffingen 1983-1985'.

she jerks her head upwards, saying slowly and emphatically: 'but *what* we published was really sound. No one can detract from that.'

Koen Verhoeff had left the Phytopathology Laboratory a year earlier, to become director of the Agriculture Research Department of the Ministry of Agriculture and Fisheries. 'A new challenge like that appeals to me', he says. '[I had been] in the same place since 1970, and I thought it might be good for the department if someone else took over. [I had] spent some thirteen years involved in biological research and organizations, and [I was] a little tired of biologists, always the same faces.'[78]… 'It was time for something new.'[79]

Yes, the job also had its frustrating points, he admits. One related to his own scientific output. 'Because of an accumulation of administrative positions in the last six or seven years: membership of the boards of the biology subfaculties in Utrecht and Amsterdam, the chairmanship of the Biology Fact-Finding Committee and the Biology Council, as well as my activities with the Central Bureau of Fungal Cultures in Baarn, I was no longer able to fulfil expectations … in terms of research output.'[80]

Another frustration related to the administration of the University of Amsterdam. 'I had dealings with two university administrations, Utrecht and Amsterdam, and I have to say that the unbusinesslike approach of the Executive Board of the UVA was extremely frustrating for me as chairman of the department, and as a member of the board of the sub-faculty. Amsterdam is very badly organized, and those at the top are evidently unable or unwilling to do anything to improve it…. In Amsterdam people were notified of their impending dismissal and then heard nothing for years as to whether or not this decision was actually to be implemented, whereas in Utrecht the business [TVC] was set up later and completed earlier.'[81]

Just as Ritzema Bos had done at the beginning of the century, Verhoeff too left of his own accord, to pursue his career elsewhere. And just as Bos's move had done, Verhoeff's departure too triggered a serious crisis for the Phytopathology Laboratory.

78 'Interview met prof.dr. K. Verhoeff', *Vakblad voor Biologen*, 67, 1987, p. 100.
79 Interview with K. Verhoeff, 22 February 2005.
80 K. Verhoeff, 'Een wetenschap in twee richtingen met drie geldstromen', farewell address of 21 January 1987, *Vakblad voor Biologen* 67, 1987, pp. 97-100, cit. p. 99.
81 'Interview met prof.dr. K. Verhoeff', *Vakblad voor Biologen*, 67, 1987, p. 100.

Aerial photograph, Willie Commelin Scholten Phytopathological Laboratory, c. 1986. Reproduced by courtesy of Nyckle Fokkema.

8 Charity begins at home

'It has become a tradition to start each year with a summary of what the past year has meant to the department and to reflect on what the new year has in store for us', remarked Schippers on 5 January 1987, in his first New Year's address to his staff as the Laboratory's new director.[1]

Who better to look back? At 54 years of age – for 28 of which he had worked at the Phytopathology Laboratory in Baarn – he could still recall the days when Westerdijk and her housekeeper had lived there. It took an effort of

Bob Schippers. Reproduced by courtesy of Bob Schippers.

[1] Text of address of 5 January 1987, handwritten, in the documents of Bob Schippers, archives of the WCS.

the imagination to recognize that past in the complex he was standing in now. A corridor connected the Phytopathology Laboratory to the white building of the Central Bureau of Fungal Cultures (CBS) on Oosterstraat, like an intact umbilical cord. The old Villa and 'Madoera' coach-house had been renovated several times and modernized: besides central heating, telephones and electric lighting, a computer network was now being installed. The Villa had a wing with brightly illuminated rooms and modern laboratories, and there was a little electricity substation in the garden. And quite recently, in November 1986, the board and staff had gathered for the festive opening of a brand-new greenhouse. The entire complex had a hyper-modern look to it – as befitted an internationally renowned laboratory, said Schippers.

Phytopathology itself had changed beyond recognition since Westerdijk's time. It had undergone explosive growth, from a small and clearly defined area of science to a ramified international network of specialisms and sub-specialisms. The almost inevitable result had been an enormous fragmentation in research, but on the other hand, the immense expansion had generated countless opportunities for cooperation between teams. Modern communication technologies made it easier and more attractive for teams to work together at both national and international level.

'We can be well satisfied with our research output, in terms of both quantity and quality', said Schippers, midway through his speech. 'It is interesting to see the growing demand in society for… fundamental insight into … possible ways of manipulating the resistance properties of plants to ward off disease and of manipulating antagonistic organisms to protect crops and to improve growth and yield; two areas in which our department has ample experience as well as expertise and enthusiasm. This is not only our own view; it is the view of [our partners in] the Netherlands, judging by the teams that have sought, and continue to seek, to collaborate with us.'

After Verhoeff's departure and the disbandment of the virology team, two project teams remained. Team I (three permanent research staff, five PhD students) focused on 'the ecology of pathogenic and saprophytic microorganisms'. It was led by Bob Schippers, who had now also taken over as director. Team II (four permanent research staff, four PhD students, two industry-funded researchers) focused on 'mechanisms of susceptibility and resistance', and was headed by Doekle Elgersma.[2] Counting laboratory technicians, assistants and administrative personnel, the Laboratory had a total staff of 35.

[2] This was the situation on 1 January 1988, as noted in the WJPLWCS for 1987. For purposes of comparison: a year earlier, on 1 January 1987 (the date of Verhoeff's formal departure from the Laboratory) the situation was as follows, according to the WJPLWCS for 1986: team I: three permanent staff and four PhD students; team II: four permanent staff, four PhD students and one researcher funded by industry.

'The government has basically made it clear', continued Schippers, 'that it cannot continue to finance the large number of increasingly expensive universities to the extent it has been doing, and is aiming to achieve a smaller number of university research centres.... To ensure that our fundamental research stays ahead of the game, we must develop even closer ties with the research being done by teams elsewhere, if possible with both the UVA and Utrecht.' And then he pronounced the ominous words: 'If we cannot do so with both, it will be necessary, in good time, to choose between them.'

'Can those things fly?'

In collaboration with the Research Station for Arable Farming and Field Production of Vegetables in Lelystad, Schippers and his team had carried out a series of experiments in the summer of 1986 in the potato test plot 'De Schreef', near Dronten. The idea was to test whether bacterization with *Pseudomonas* would produce a higher potato yield. Now, for the first time, they also tested the effect of genetically modified bacteria.

According to the Netherlands Society for Nature and Environment (Stichting Natuur en Milieu), these experiments were illegal, because the team had omitted to apply in advance for the necessary licence under the Nuisance Act. It had quite properly applied for approval to the Ad-hoc Recombinant DNA Activities Commission, which approval was duly granted, since the Commission judged that the research posed no threat to the environment. But according to Schippers, the Commission had failed to point out – from ignorance – that the team would also need a licence under the Nuisance Act to carry out these experiments.[3] Not until the Netherlands Society for Nature and Environment had instituted legal proceedings had they applied for one. By then, the experiments had long been completed. In a public hearing at Dronten town hall at the beginning of March 1987, both sides were given an opportunity to present their case.[4]

'To the dismay of the mayor, who was presiding over the hearing, the Nature and Environment people did not show up', recalls Schippers. 'But our explanation of the experiment, which in our eyes posed no danger at all, did elicit questions from worried farmers, like: "can those things fly, then, and get into our houses?" We finally got away with nothing worse than a reprimand from the Ad-hoc Recombinant DNA Activities Commission.'

[3] It was not the task of this Commission, however, to alert the scientists to the need to apply for a licence under the Nuisance Act. Whether it was in fact ignorant of the need for such a licence is questionable.

[4] See also 'DNA-experiment in open veld zonder vergunning', in *U-blad* of 6 March 1987, p. 5.

By this time, the ties forged between the Laboratory and the molecular biologists Professor Peter Weisbeek and Professor Ben Lugtenberg had become really crucial to Schippers' own research area – the rhizosphere. What happened below ground was still invisible; even when the researchers jettisoned their regular earthenware pots in favour of plexiglass or specially designed glass pots, the underground movements of soil micro-organisms and their interactions with other soil pathogens and the plant root were still hidden from observation. The techniques of molecular biology changed all that. They did not literally shine a light into the darkness, but they did make it possible to change certain properties of the *Pseudomonas*, hence indirectly providing the evidence for their function.

'This enabled us to prove that some *Pseudomonas* strains did in fact secrete specific siderophores that helped them win the battle for the available iron', says Schippers.[5] These *Pseudomonas* strains had more, and more effective, siderophore receptors than pathogenic fungi and many other bacteria. This meant that they were capable of quickly grabbing the available iron in the soil – at the expense of the pathogens. That helped to explain how they stimulated growth, in potatoes for instance.

The crucial evidence came from the *Pseudomonas* strains in which the gene responsible for siderophore production had been deactivated. These strains no longer had any competitive edge in the struggle for iron, and also lost their capacity to suppress disease and stimulate the plant's roots. In theoretical terms, this explanation of the growth-promoting properties of *Pseudomonas* raised a new problem: for if the healthy root was colonized in natural conditions by this small, iron-eating bacteria – is that root, which also needs iron to grow, not equally at a disadvantage? 'Experimentally it could be demonstrated', says Schippers, 'that this was not necessarily the case.'[6]

'Our collaboration with the molecular biologists forced us to look for a simpler and faster experimental plant/pathogen/*Pseudomonas* model', explains Schippers. 'We ended up (linking up with the research being done in Elgersma's team) with carnation/*Fusarium* wilt/*Pseudomonas*, and somewhat later with radish/*Fusarium* wilt/*Pseudomonas*.'

In May 1986, the ecological project team launched a research project that focused on the possibility of suppressing *Fusarium* wilt in carnations by using bacterization with *Pseudomonas* strains. 'The striking result achieved here was

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[5] P.A.H.M. Bakker*, Siderophore-mediated plant growth promotion and colonization of roots by strains of Pseudomonas spp*., PhD thesis Utrecht, 1989.
[6] See also B.J. Duijff, *Suppression of Fusarium Wilt by Fluorescent Pseudomonas spp.*, PhD thesis Utrecht, 1994.

that treating susceptible cultivated varieties of carnation with WCS417 sharply reduced the number of diseased plants, while more moderately resistant varieties only retarded the disease process', as Schippers noted in the annual report for 1987.[7] 'Treatment with WCS358 and WCSX13 caused a 50% reduction (in relation to the control specimens) in the number of diseased plants.'

The growth-promoting effect of *Pseudomonas* was not only the result of a successful competitive struggle for iron; a second disease suppression mechanism was also involved. This second mechanism, which was initiated by *Pseudomonas*, turned out to be triggered by structures protruding from the *Pseudomonas* cell wall, including lipopolysaccharides and certain siderophores – but a clear analysis of the entire process of induced systemic resistance was not produced until much later, and by a different branch of the laboratory.[8]

In retrospect, explains Schippers, the discovery that *Pseudomonas* strain WCS417 could generate induced systemic resistance (ISR) to *Fusarium* wilt was a breakthrough[9] – certainly when it turned out that exactly the same disease-suppression mechanism worked in radish.[10] When *Pseudomonas* strains with different disease-suppression properties were mixed together, the mixture turned out to enhance the effect more strongly still. The same happened when *Pseudomonas* strain WCS358 was mixed with the non-pathogenic fungus *Fusarium oxysporum* Fo47, a fungus that originated from soil that suppressed *Fusarium* wilt, or 'disease suppressive soil', in France.[11]

Eventually a third pathogen-suppressive property of a WCS *Pseudomonas* strain was observed, adds Schippers, as if to put the finishing touch to his story – it produced an antibiotic. But the further research on this property was done not at the Phytopathological Laboratory but at the Agricultural University in Wageningen (by Schippers' former PhD student Jos Raaijmakers) and in the United States.

7 The researcher was R. van Peer; this project was carried out in collaboration with Aalsmeer Experimental Station for Floriculture; WJPLWCS for 1987, p. 12.

8 R. van Peer, *Microbial interactions and plant responses in soilless cultures*, PhD thesis Utrecht, 1990; M. Leeman, *Suppression of Fusarium wilt of radish by Fluorescent Pseudomonas spp.*, PhD thesis Utrecht, 1995.

9 Written communication, 2005; R. van Peer, *Microbial interactions and plant responses in soilless cultures*, PhD thesis Utrecht, 1990.

10 In this case, with *Pseudomonas* strains WCS374 and WCS417. See M. Leeman, *Suppression of Fusarium wilt of radish by fluorescent Pseudomonas spp. Induction of disease resistance, co-inoculation with fungi and commercial application*, PhD thesis Utrecht, 1995.

11 See also P. Lemanceau (visiting scientist), P.A.H.M. Bakker, W.J. de Kogel, C. Alabouvette and B. Schippers, 'Effect of pseudobactin production by *Pseudomonas putida* WCS358 on suppression of Fusarium wilt of carnations by non-pathogenic *Fusarium oxysporum* Fo47', *Applied Environmental Microbiology* 58, 1992, pp. 2978-2982.

‘We soon realized that we could also use this as a method of biological control’, says Schippers. ‘And after all, that was still what our external financiers were hoping for.’ Together with Ruud Scheffer, head of research at the company Zaadunie NV in Enkhuizen since 1989, the Phytopathology Laboratory developed *Biocoat*, a product designed to make pesticides and steam disinfestation redundant in the growing of radishes. *Biocoat* was the name given to radish seed that was literally coated with *Pseudomonas fluorescens* WCS374 – one of the bacterial strains that activated the radish’s innate immune system. When germination took place in the soil, this *Pseudomonas* strain colonized the burgeoning root and then protected the growing radish, through induced systemic resistance, from the common soil pathogen *Fusarium oxysporum*. This form of crop protection was not only much cheaper than the labour-intensive steam disinfestation of the greenhouse soil, but it was also better for the environment.[12]

Ecology project group, c. 1985. Reproduced by courtesy of Bob Schippers.
① D.C.M. Glandorf, ② student, ③ analyst, ④ student, ⑤ B.J. Duijff, ⑥ ?,
⑦ J.M. Raaijmakers, ⑧ M. Leeman, ⑨ B. Schippers, ⑩ H. Steyl

[12] Leeman, PhD thesis Utrecht, op. cit.; B. Schippers and R. Scheffer, ‘Jas voor radijs’, *Natuur en Techniek*, June 1997, pp. 66-77.

Even so, horticulturalists were not overly enthusiastic about *Biocoat*, and the product vanished from the market almost as soon as it had arrived. 'Its benefits were too limited', says Schippers. 'In comparison to steam treatment, the increase in yield was too small. What is more, the effects fluctuated sharply, and some radish varieties sold nowadays have been bred for resistance to *Fusarium*. The 10% to 20% yield increase arising from *Biocoat* was not sufficient compensation. But in principle this would be a good way of developing biological crop protection.'[13]

'The molecular biologists wanted the biologists to provide models and research questions', says Schippers. 'And for our part we wanted to use their expertise and techniques. Pooling our resources meant that we could use the molecular knowledge and techniques without having that specialism within our own team. It worked really well.'

In the run-up to Verhoeff's departure, the desire to resume the research on genetically modified organisms had come up for discussion many times. New, expensive investments were needed, partly to comply with the increasingly stringent safety requirements. Some of those would be 'difficult to achieve' in Baarn, Verhoeff had told the biology sub-faculties at the universities of Amsterdam and Utrecht, back in August 1986.[14] But the CBS had this problem too, as everyone in Baarn was well aware, and closer collaboration could alleviate the problem to some extent. So Verhoeff added: 'A new director is being recruited for the CBS. During interviews with potential candidates, some have expressed a wish to strengthen the physiological research on fungi, which would require isotope facilities among other things.' The CBS was also thinking of buying a transmission electron microscope for 1987; a scanning electron microscope had already been installed in 1986. 'If there is to be closer cooperation with the CBS, clear agreements would be needed between the KNAW on the one hand and the UU and UVA on the other.'

Closer cooperation was already being discussed. With the increasing influence of national science policy, the two universities were feeling the pinch of tightly orchestrated research planning and no one's job was secure. 'Weak links' would have to become stronger, leave, or find new partners. Larger clusters looked more unassailable, and provided more critical mass – so that mergers became the norm and isolationism an aberration.

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13 B. Schippers, R.J. Scheffer, B.J.J. Lugtenberg, P.J. Weisbeek, 'Biocoating of seeds with plant growth-promoting rhizobacteria to improve plant establishment', *Outlook on Agriculture* 24, 1995, pp. 179-185.

14 Board of the phytopathology dept. to the biology sub-faculties of the UU and UVA, 20 August 1986, archives of the WCS.

The rightful place of phytopathology was another frequent topic of discussion. With a view to Verhoeff's departure, the University of Amsterdam considered forming a single department, 'Biology of Disease and Pests' as part of a Conditional Funding Programme of that name. The researchers in the phytopathology department would join those attached to the department of applied entomology to work in a new laboratory to be built at Anna's Hoeve university campus – at least, that was the idea. Utrecht University also saw Verhoeff's departure as an opportunity to create new working structures. In order to place the existing cooperative relationships within the experimental botany cluster on an even firmer basis, one possibility would be to put the departments of phytopathology, botanical ecology and plant physiology together in premises at the Uithof university campus.

Theoretically, these options would strengthen the internal cooperation between the different departments, and a knock-on effect would be to enhance the universities' positions in relation to each other. In these times of shrinking budgets, this latter point, in particular, was a life or death matter for universities; certainly given that budgets were partly based on student numbers, and the quality of research was an important weapon in the competition to attract students. There was really only one major drawback: the split would deal an irreversible blow to the team in Baarn.

As long as Verhoeff was still in charge, that was crystal-clear. 'The staff paid by the participating universities in the department's different project teams are so closely intertwined,' wrote Verhoeff, 'that splitting them up according to university or according to project team would be tantamount to abolishing the discipline of phytopathology within the universities. Both universities should maintain their interests in the department, regardless of its location.... The phytopathology department constitutes a single entity and should be regarded as such in the future.'[15]

The universities unanimously echoed this position: 'the two boards of the biology sub-faculties of the UVA and the UU will continue to regard the department as a single entity. On scientific grounds, there is no reason to merge the departments of applied entomology and phytopathology. This view is shared by the boards of both sub-faculties.'[16] They continued: 'For the departments concerned to occupy shared premises in Utrecht is not a condition for the formation of an "experimental botany" cluster. The options for upgrading apparatus together with the CBS are being investigated.'

15 Board of the phytopathology dept. to the biology sub-faculties of the UU and UVA, 20 August 1986, archives of the WCS.

16 Minutes of the 117th board meeting of the WCS, 26 November 1986, archives of the WCS.

Mutually enhancing effects

'Induced resistance appears to play an important role in the biological control of elm disease', wrote Elgersma in the annual report for 1987.[17] The main question now was which micro-organism was most effective in preventing symptoms if injected before inoculation with *Ophiostoma ulmi* – in other words, which (extraneous) substance stimulated the tree most effectively to develop an immune response.

'Preventive injection with *Pseudomonas* strains produced highly variable results', says Elgersma. 'It worked well with some elm clones, such as the fairly resistant "Commelin" and the "Vegeta", but with other trees, especially the highly susceptible field elms *Ulmus carpinifolia* and *Ulmus procera*, it had little or no effect. Even so, these experiments put us on the right track.'

When tested *in vitro*, several *Pseudomonas* strains behaved very differently in relation to *Ophiostoma ulmi*: some had a far more pronounced antagonistic effect than others. The classic explanation for this was that the *Pseudomonas* strains differed in their production of antibiotics. In the field, however, these differences sometimes vanished altogether.[18] 'This observation and the clone dependent effect suggest that the major mechanism explaining this biological control is most probably related to induced resistance in the host tree rather than to a direct antibiosis between bacterium and pathogen', wrote Elgersma, Roosien and Scheffer in 1993.[19]

'You can perfectly well compare it to a human reaction', nods Elgersma. 'An immune response is triggered by an intruding foreign body. If there is a second intruder, in this case the pathogen that causes elm disease, for instance, it has little or no chance of spreading through the vessels, since the tree has already closed them off in reaction to the first intruder. The funny thing is, of course, that the tree does not become diseased from that first intruder, and is protected from the second. We didn't know exactly how this mechanism worked, but it certainly worked.'

In the latter half of the 1980s, the researchers tested and compared the disease-suppressive effect of different micro-organisms, including mixtures of aggressive and non-aggressive strains of *Ophiostoma ulmi*, and isolates of the common vascular pathogens *Verticillium albo-atrum* and *Verticillium dahliae*. The latter, in particular, appeared very promising.

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17 WJPLWCS for 1987, p. 21.

18 R.J. Scheffer, 'Mechanisms Involved in Biological Control of Dutch Elm Disease', *Journal of Phytopathology* 130, 1990, pp. 265-276.

19 D.M. Elgersma, T. Roosien and R.J. Scheffer, 'Biological Control of Dutch Elm Disease by exploiting Resistance in the Host', in M.B. Sticlen and J.L. Sherald (eds.), *Dutch Elm Disease research: cellular and molecular approaches,* New York, Springer Verlag, 1993, pp. 188-192, esp. p. 188.

'In an experiment near Eelde, field elms were pre-inoculated with *Verticillium dahliae* (an isolate that proved not to have pathogenic properties for the elm); none of these trees subsequently became diseased after inoculation with *Ophiostoma ulmi*. Of the eleven trees in the control group that had first been inoculated with water, ten became diseased', wrote Elgersma in the annual report for 1988. 'In a similar experiment in a wood near Lelystad, all the control trees succumbed to disease, while seven out of ten of the trees that had first been inoculated with *Verticillium dahliae* remained healthy. Given the fairly high infection pressure in this wood, it is possible that the three trees with symptoms had already been infected *before* inoculation with *Verticillium dahliae*.'[20]

So it seemed as if healthy elms did not succumb to disease if they had been pre-inoculated with a suspension of the fungus *Verticillium dahliae* before inoculation with *Ophiostoma*. Still, to establish the value of this claim, experiments would have to be conducted on a larger scale. The scientists of the Phytopathology Laboratory had neither access to a large enough test plot nor the necessary human resources to do this.

'These experiments were really very tricky to organize', says Elgersma. 'Where do you find enough trees to experiment on? What made matters worse was that diseased trees had to be chopped down straight away at that time. So you had just set up a series of experiments, with controls and everything, and then they would have to be chopped down because some trees a few rows away had suddenly turned out to be diseased. End of experiment. So we contacted the Netherlands Land Development Society (Nederlandse Heidemaatschappij).' That Society not only managed large areas of woodland, but it also had an interest in developing a remedy for biological control. 'Commercialization is now a practical problem', summarizes the annual report for 1988.[21] 'There was another practical problem', says Elgersma. 'Field research on elms could really only be done in May and June. So we spent the rest of our time researching another vascular pathogen.'

Back in Verhoeff's days, physiological research had already been grouped around two species of pathogenic fungi: the very common *Botrytis cinerea* and a few more or less specialized vascular parasites occurring in tomato and carnation. The research done on *Botrytis*, with French bean and tomato as host plants, focused, according to the annual report, on 'factors relevant to infection: a variety of environmental factors, including exogenous, infection-stimulating nutrients, and cutinolytic and pectolytic enzymes.' This was the research on 'attack' mechanisms that had started under Verhoeff.

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20 WJPLWCS for 1988, pp. 21-22.

21 WJPLWCS for 1988, p. 21.

Resistance and susceptibility project group, October 1988. Reproduced by courtesy of Bob Schippers.
From left ro right (back row): G.T.N. de Leeuw, K. Pie, S. v.d. Molen, ?, J. v.d. Heuvel, D.M. Elgersma; (front row): P. Kasteleyn, B. Kroon, ?, L.I. Liem

Elgersma wrote about this research in 1987: 'Although horticulturalists, especially those involved in ornamental plant cultivation, are calling ever more urgently for fundamental research on *Botrytis cinerea*, the department has decided to wind down the *Botrytis* research within the project team in about three years' time. The aim is to pool resources more in research on vascular parasitism and to shift the accent to a more molecular biological approach.'[22]

The research on vascular parasitism had also begun back in Verhoeff's time, and was now concentrating, according to the annual report, 'on the pathogenicity factors in the pathogen – but the accent lies on research into resistance mechanisms'[23] – in other words, on defence. Just as in the case of the *Botrytis* research, this too was largely biochemical in nature. The aim was to find out how the plant (carnation or tomato) defends itself against a pathogen (*Fusarium oxysporum*), and whether there were any discernible differences in this regard between resistant and susceptible plants. 'In principle the same

22 WJPLWCS for 1987, p. 16.
23 Ibid., p. 16.

research question as with the elms', says Elgersma. 'The difference was, though, that this research could be done in the Laboratory – in other words, all year round.'

A carnation that is resistant to *Fusarium* wilt can encapsulate the pathogen in vascular tissue. The plant ensures that its vessels are blocked with gum, the cell walls of the surrounding parenchyma cells become lignified and suberized, and a variety of phytoalexins are formed – as a result, the fungus is trapped and its growth is inhibited. But what are the precise factors determining the level of resistance, and what metabolic processes and anatomical changes are most effective in encapsulating the pathogen?[24] An international research project (whose participants included the Institute for Horticultural Plant Breeding (IVT) in Wageningen, the Experimental Station for Floriculture in Aalsmeer, the Central Bureau of Fungal Cultures in Baarn, the Institute for Atomic and Molecular Physics in Amsterdam, the TNO-CIVO Toxicology and Nutrition Institute, and teams in France (Antibes) and Germany (Freiburg)) explored the different aspects of this question in five main research lines.[25]

Again, induced resistance was only one factor – though an interesting one: was a non-pathogenic isolate of *Fusarium oxysporum* f. sp. *dianthi* capable of inducing resistance? And if so, what were the accompanying biochemical changes in the production of phytoalexins?[26]

'This project demonstrated the mutual influence between fundamental and applied research', says Elgersma. 'Growers needed testing methods, to find out quickly which carnations were resistant and which weren't. By doing fundamental research, we could identify the resistance mechanisms that were active in carnations, and help find faster methods of testing.'

'We also wanted to do more with molecular techniques', he continues. 'Otherwise we would miss the boat, it was as simple as that. External funding was becoming more and more dependent on molecular biology. But I am not, and never have been, a molecular biologist. Neither was Verhoeff, I might add.'

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24 PhD student R.P. Baayen was the driving force behind this rsearch. He was awarded his PhD (*cum laude*) on the strength of a thesis on this topic in 1988. See R.P. Baayen, *Fusarium wilt of carnation: disease development, resistance mechanisms of the host and taxonomy of the pathogen*, PhD thesis Utrecht, 1988.

25 WJPLWCS for 1988, p. 19. The five main research lines were as follows: (1) analysis of the components of the resistance reaction. A knowledge of the biochemistry of the resistance processes is needed in order to correlate specific processes quantitatively with the partial resistance to the general physiological race 2. (2) research into the causality of correlations that have been found: are there resistance-determining factors, or merely resistance markers? (3) research on the expression of resistance to other races of the pathogen. (4) analysis of inheritance in carnation of resistance to the different races. (5) analysis of the mutual relationships between different races.

26 WJPLWCS for 1988, p. 19.

He pauses briefly. 'When Verhoeff left, we decided that his successor, who would also be the professor heading our project team, had to be well versed in molecular knowledge and techniques.' Why insist on that condition? Elgersma replies quickly. 'You can use external channels to get that expertise, as Schippers and his team did – and very successfully too, no doubt about it – but I thought that would make you too dependent on the outsider's moods and quirks. Today's friend can easily become tomorrow's enemy in the world of science. And then you're really stuck. We wanted to have that expertise on our team – so the new professor would have to have it. With a molecular scientist on board, we would really be able to ratchet up our research.'

This preference made filling the Verhoeff vacancy a routine affair. A few details would change: the new professor would be appointed only at the University of Amsterdam (instead of half at Utrecht and half at Amsterdam),[27] and he would not automatically become director of the Willie Commelin Scholten Phytopathology Laboratory. For in November 1986 – at the last meeting of the Foundation's board attended by Verhoeff as director, a festive event – the board had already invited Schippers to accept that position.[28]

For the rest, however, it was business as usual. The Phytopathology Laboratory had stated in broad outline its needs for the future, and the research team that the new professor would be leading had put forward some guidelines for the appointee's profile.

With these conditions in place, the biology sub-faculty of the University of Amsterdam launched the procedure in the autumn of 1986. It started by setting up a structural committee (21 October 1986). This met twice (on 27 November 1986 and 15 January 1987), and then submitted a thirteen-page structural report to the biology faculty council (27 May 1987), which discussed and amended it (16 June 1987) before sending it on to the executive board for approval.

In the meantime, the board of the WCS Foundation was busily making plans to renovate and expand the laboratory in Baarn. At preliminary talks with representatives of the two executive boards, it emerged that the government had imposed restrictions on the amount of space to be occupied by university departments, which meant that any expansion of the laboratory in Baarn would

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[27] Since Schippers already had a full-time professorship at Utrecht University, Wieringa-Brants's chair at the University of Amsterdam would fall vacant after her resignation and Verhoeff's 'successor' would take over this position, so that the phytopathology professorships would again be neatly divided betwen the two universities. And to complete the situation: besides a full-time appointment at one of the universities, both professors would have a so-called 'zero appointment' at the other one.

[28] Minutes of the 117th meeting of the board of the WCS Foundation, 26 November 1986, archives of the WCS.

be at the expense of new buildings at Anna's Hoeve in Watergraafsmeer. But the chairman of Amsterdam's executive board, Dr Roel Poppe, waved this aside, noting that 'charity begins at home, and the phytopathology department can be regarded as home.'[29] That was at the end of June 1987.

The summer holiday ended with a jolt, when the Free University suddenly announced its intention to withdraw from the financing of the Willie Commelin Scholten Phytopathology Laboratory on 31 August 1990, and to abolish the staff position it was paying for, which until then had been occupied by phyllosphere researcher Fokkema.[30] What is more, the biology faculty of the University of Amsterdam terminated its rental agreement with Baarn as of 31 December 1989.

'To summarize a long debate, it may be said that the roughly 1,000 square metres occupied by the faculty in Baarn will have to be sold off', wrote Bart Wassenaar on behalf of the faculty of the University of Amsterdam on 16 October 1987. 'Faced with this inescapable fact of life, we deliberated on how it could be reconciled with our view that phytopathology should be retained as part of the faculty's profile.' Essentially, three options remained: (1) the entire department could move to Watergraafsmeer in Amsterdam; (2) the department could remain in Baarn, but without the University of Amsterdam paying rent after 1990; (3) the department could be split up, with part moving to Amsterdam and part to Utrecht. The first of these options was the one preferred in Amsterdam, Wassenaar added on the faculty's behalf – although this did mean that the accommodation expenses would have to be shared by Utrecht University, the University of Amsterdam, and, 'if it did not withdraw', the Free University.

'In the summer of 1987, officials arrived with tape-measures', recalls Gerard de Leeuw. 'They crawled all over the place. They even measured the toilets. But they will never shut us down, we told each other. Less than a year ago a brand-new greenhouse had been opened in the Laboratory's gardens. That thing had cost … what was it?… I think it must have been 700,000 guilders. Paid for by the universities. Such an enormous destruction of capital – they would never get it through. We thought.'

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29 Memorandum of the consultations in Amsterdam, held on 22 June 1987, concerning the phytopathology department, 7 July 1987, archives of Bob Schippers.

30 'Concept-formatieplan Faculteit Biologie 1988-1992', 16 September 1987, p. 10, archives of the WCS; Fokkema did not wait around for this to happen, and left in February 1988, accepting a post at the IPO in Wageningen. With his departure, the end of phyllosphere research in Baarn was in sight.

Temperature-controlled glasshouse, c. 1986. Reproduced by courtesy of Bob Schippers.

Up against the wall

In 2005 it emerged that files had been preserved on the closing of the Willie Commelin Scholten Phytopathology Laboratory in the universities' administrative buildings. Besides this, former director Bob Schippers and former staff member Nyckle Fokkema had kept files of their own at home. Once arranged in chronological order, this mountain of paper helps explain the course of events.

To begin with, there is a curious letter from the Royal Academy of Arts and Sciences – or rather, it is the date on the letter that is curious. Four days before Wassenaar notified all interested parties of the University of Amsterdam's position, on behalf of the biology faculty, the Academy observed 'with considerable unease the latest round of cuts, functional constraints and reorganizations imposed on the universities, which threaten to undermine the unity of the WCS by dividing its staff between the universities of Amsterdam and Utrecht.'[31] Was the decision already made then? Or was the generally so prudent Academy now suddenly running ahead of events?

The first consultations (of which minutes were recorded) between those concerned in Baarn, on 27 October 1987, reveal that much uncertainty remained. The dean of the biology faculty in Utrecht regretted that the UVA had 'pushed [the UU] into a corner in this way'.[32] He was astonished that the letter concerned contained 'nothing whatsoever about the substantive, scientific interests that should always take precedence.' It seemed to him that 'all that counted was the financial side of things and the number of square metres.' The chairman of the WCS Foundation endorsed this view.

The dean of the biology faculty in Amsterdam hurriedly dodged responsibility; it was the UVA's executive board that was 'not prepared to finance the essential facilities and rent increase mentioned in the Phytopathology Structural Report' and had therefore returned the report to the faculty: 'it is regrettable', said the dean, according to the minutes, 'that neither the department nor the Foundation was informed of this.' But by initially approving the Structural Report, the faculty had indicated that it *did* agree with the lines along which the research should develop, as laid down in that report. So in terms of substantive, scientific interests, he concluded grandly, there was no problem whatsoever.

[31] KNAW to the Executive Boards and the boards of the biology faculties of the UVA, UU and VU, 12 October 1987, archives of the WCS.

[32] Consultations between the deans and directors of the biology faculties of the UVA and UU, the chairman and treasurer of the WCS Foundation, and Elgersma, Mrs Schellingerhout-Huyg [administrator/secretary] and Schippers on behalf of the phytopathology department, in Baarn, on 27 October 1987, archives of the WCS.

Yet only in June, that same executive board had called Baarn part of the 'home' where charity was supposed to begin. Why had it slipped from this position? And why had the Academy evidently been notified, while the Foundation had not? And what was to be done now?

A fourth option had to be added to the three already under consideration, it was decided: 'as option 1, but in Utrecht.' And finally, it was desirable to make a decision in the short term, if only 'to safeguard the social security interests of the staff as well as possible'.

In the event, it was not until October 1988 – over a year later – that the final decision was taken to close the Willie Commelin Scholten Phytopathology Laboratory, moving one of the project teams to Utrecht and the other to Amsterdam.

The records show that it took three official consultations between the biology sub-faculty boards of the two universities and members of the department and the Foundation,[33] before both boards decided, in December 1987, that a split was the most practicable solution, and asked their respective faculty boards to make the necessary arrangements. But before these boards reached the same conclusion, they once again considered a wealth of other options, while a long line of professors from within and outside the universities, and over thirty organizations, large and small, in the Netherlands and abroad, all expressed their opinions, and the division of the joint property in Baarn regularly featured on the front pages of the university papers.

The records show the same arguments and considerations being constantly rehashed: the phytopathology department owes its scientific quality to the unity of research and teaching built into Baarn, which unity would be seriously jeopardized by a split (argument in favour of keeping Baarn); if the Laboratory is split up, the research must be firmly embedded in the universities' research plans (general argument used on both sides); the investments and renovations needed to sustain Baarn exceed the universities' budgets (argument for closure); Baarn's isolated position makes its preservation undesirable in any case from the vantage point of scientific collaboration and educational infrastructure (argument for closure).

The decision to close the Laboratory and simultaneously to set up two new phytopathology project teams, one at each of the two universities, therefore seems to have been the logical outcome of a consideration of 'all relevant arguments and possible solutions.'[34] But neither the 'Joint Declaration of the

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[33] On 27 October 1987; on 20 November 1987; on 4 December 1987, archives of the WCS.

[34] 'Gemeenschappelijke Verklaring van de Colleges van Bestuur van de Universiteiten van Amsterdam en Utrecht inzake het Laboratorium voor Fytopathologie in Baarn', 24 October 1988, archives of the WCS.

Executive Boards of the Universities of Amsterdam and Utrecht regarding the Phytopathology Laboratory in Baarn' nor the large pile of paperwork that preceded it answers the question of how a matter of succession could have metamorphosed so drastically into one of closure. What – or who – was the decisive factor?

'Too much'

Dr Hans Amesz has an office in a quiet corridor in one of the wings of the eight-storey F.A.F.C. Went building – also known as the 'punch card', from the apparently random design of its windows and exterior panels – at the Uithof complex in Utrecht. Amesz was director of the biology faculty of Utrecht University, and since the early 1990s he had also served as secretary of the Willie Commelin Scholten Phytopathology Laboratory Foundation. He has since taken early retirement.

He can no longer recall the precise details. But of one thing he is certain. 'Amsterdam suddenly pulled the plug out', he says. 'I don't know if everything would have unravelled so quickly otherwise. In Utrecht, in any case, no one was thinking of closing the Laboratory down at that time.'[35] The documentary evidence seems to confirm his interpretation.

Utrecht University was also collectively absorbed in the aftermath of the Selective Shrinkage and Growth Operation (SKG), the bureaucratic implementation of one of the last rounds of financial cuts imposed on the universities by central government in 1984. The 1988 Organizational Plan for the Biology Faculty of Utrecht University, bound in a cheerful green cover, announced a 15% cut in personnel imposed in April 1987 by the executive board, to be achieved before 1992, including a reduction of approximately 10% in the faculty's total Conditional Funding Programme.

In other words, more jobs were going to be lost, after the initial round of cuts already pushed through in 1984. In response, Utrecht University had drafted an 'SBK II', a Social Policy Framework providing a financial reserve so that 'surplus' personnel could take early retirement. When the biology faculty council had discussed the memorandum 'Adjustment of the 1984 Organizational Plan for the Biology Faculty' in December 1987, most attention had focused on the proposed personnel cuts in the departments of plant taxonomy and plant geography, population and evolution biology, theoretical biology and palynology and palaeobotany, as well as in the project teams secondary metabolism, histology and cell biology, aquatic toxicology and biological toxicology; in other

[35] Interview with W.J.C. Amesz, 20 June 2005.

words, the phytopathology department was excluded from these reorganizational talks. Even in the final Organizational Plan adopted in March 1988, the phytopathologists were still regarded – 'pending the outcome of talks between the UU and the UVA' – as part of the main discipline of experimental botany.

For Utrecht University, the research in botanical ecology as practised in Baarn was actually part of one of the three main subjects (botanical ecology) with which the biology faculty sought to distinguish itself nationally – according to the Profile Memorandum (*Profileringsnota*) that the faculty council had discussed in February 1987. Botanical ecology (part of 'experimental biology') was 'a formula for success … it is not only one of the core disciplines of the faculty of biology in Utrecht, but [it also fulfils] a pioneering role within ecology in the Netherlands.'[36] Not until the very last moment, when both executive boards had drafted their final statements (Amsterdam on 13 October 1988 and Utrecht a week later, on 20 October), and the closure was sealed – only then, on 27 October 1988, did the faculty council finally alter the organizational position of the phytopathology department: 'As a result of the decision to bring to an end, in the not too distant future, the collaboration between the biology faculty of the University of Amsterdam and the biology faculty of Utrecht University in the discipline of phytopathology in Baarn, the Utrecht phytopathology project team will be incorporated, as a project team, into the department of botanical ecology and evolution biology.'[37]

'You see, once it was clear that Amsterdam really didn't want to carry on, it was also very clear that we had to wind everything down quickly and correctly', says Amesz. 'Our rector, Professor Hans van Ginkel, was adamant about this. You can't leave people hanging on interminably, was his view. If it's all got to be divided up, let's do it quickly. It was he that got things moving quite fast at some point. But I must stress: that was only when it had become clear that Amsterdam was really not willing to carry on.'[38]

Bart Wassenaar took several weeks to reply to my e-mail. As retired director of the biology faculty of the University of Amsterdam, he had spent the summer sailing around the Baltic, he said with an apologetic little laugh, when we finally met on the terrace of Hotel Americain in Amsterdam.[39]

[36] 'Organisatieplan Fakulteit Biologie Rijksuniversiteit te Utrecht 1988', p. 10.
[37] Ibid., *addendum*, p. 25.
[38] Confidential documents reveal that this moment was reached in July 1988; confidential report of talks held between G.S. Roosje (chairman of the WCS), Professor J.A. van Ginkel (CB, UU), Professor G.A. van Arkel (dean of biology faculty, UU), G.J.D. Berendsen (Personnel and Organization Dept., UU), 25 July 1988, archives of the WCS.
[39] Interview with E.O.M. Wassenaar, 11 July 2005.

'You should not place too much reliance in my memory', he had warned me beforehand. 'In my time at the UVA, I was given little else to do except turn things upside down in several different departments. In my own past, the word 'reorganization' is not attached exclusively to biology.' One of the first things he did after being appointed director in 1985 was to finalize the implementation of the 'Total Plan for 1983-1988' – a reorganization plan arising from the final report of the Biology Fact-Finding Committee (*Verkenningscommissie Biologie*). This Committee, chaired by Verhoeff, had been set up by the education ministry in 1982, its mandate being to draft a total plan for biology research at national level. It had screened and assessed all the research at the biology sub-faculties and the biology institutes of the KNAW at the beginning of 1983 and published its findings in a thick volume entitled *Van Levensbelang* ('Life Matters'). The next thing was to coordinate at national level the various interventions deemed necessary at each institute. So a national Research Allocation Committee was set up to decide how personnel cuts averaging 20% in 1986 should be divided up among the various institutes.[40]

In advance of this decision, the biology sub-faculty of the University of Amsterdam had already set up its own 'Restructuring Steering-Committee' back in 1981, the aim being to evaluate the 'restructuring of research and education [that had been] in progress for many years', and independently of the *Van Levensbelang* report it had prepared its own Total Plan for 1983-1988. Given the prior conditions laid down for the reorganization, this plan foresaw the disbanding of Wieringa-Brants's project team on 'resistance mechanisms of plants against viral infections' as early as 1983 (see previous chapter). 'Oh, you're from the inquisition', says Wassenaar. 'That's how they greeted me when I first went to Baarn.'

'That Total Plan spanned five years', explains Wassenaar. 'But just like in Yugoslavia, it was modified one year later. And a year later the modification was modified. And so it went on. Since the existing situation kept being woven in, the modified version only looked like the original plan if you looked at it from the moon.'

He cannot recall the details of the closure of the Baarn laboratory, but that square metres loomed large makes sense to him. 'Cuts had to be made over and above the existing planning', says Wassenaar. 'That was the first thing. And that square metres guideline, that every university of a certain size could only have so many square metres, that was one of the ways in which central government tried to get more influence. At the UVA we had, if I remember rightly,

[40] GAA 1020, FWN, inv. 602: 'stukken betreffende TVC in verband met samenwerkingen en opheffingen 1983-1985'.

340,000 square metres. About half of that had to go. The executive board charged the faculties 300 guilders for every extra square metre. We tried to distribute the misery as much as possible, but Baarn had far too many square metres for such a small staff. That, added to the ongoing debate on which subdisciplines we had to select for the general cuts, confirmed the initial idea that come what may, phytopathology had to be moved to Amsterdam and transformed into a section in the new departmental classification system.'

One could not quarrel with the figures on which Amsterdam's decision was based. Keeping Baarn, according to an internal memorandum dating from June 1988, would need a one-off investment of 300,000 guilders, followed by an annual contribution of 249,400 guilders for a minimum of ten years. Dividing the teams up and incorporating them into the new buildings in Amsterdam would require a lump sum of 120,000 guilders plus 5,000 guilders a year. 'So the extra costs attached to retaining the Baarn institute amounted to a one-off investment of 180,000 guilders and an annual sum of 245,000 guilders for a minimum of ten years', the report states baldly.[41]

The report lists two problems involved in keeping Baarn. First, it would mean exceeding the square metre limit, and second, a large injection of capital would be needed to provide Baarn with the apparatus it needed to do the desired molecular research. The departments located at Anna's Hoeve already had this apparatus, the report points out. 'Given our present financial predicament, the faculty cannot give priority to an investment involving the inefficient duplication of equipment.'[42]

Wassenaar briefly stares into the distance. 'The faculty was in financial chaos when I arrived. Mountains of files numbered AM 095, I still remember that.' He laughs softly. 'All filled in quite properly, no doubt about it, but no one had a clear view of the whole. They were just sitting there, and they kept on piling up. And that applied to the whole university, you know, not just to biology. And then the whole university suddenly had a shortfall of 45 million guilders, in the autumn of 1986.... or was it 1987? Panic broke out. An immediate freeze on recruitment. No, it was years before the University of Amsterdam had a reasonable separation between management and the executive. ... Executive decision-making in Amsterdam was –' Wassenaar hesitates briefly – 'very turbulent', he concludes diplomatically.

On paper, there was a fine-tuned division of tasks and responsibilities – the rage for democratization had not yet burnt itself out – but in practice, an endless jumble of reports, memoranda, total plans issued by committees,

[41] 'Notitie inzake de toekomst van het onderzoek in de fytopathologie', DOO, UVA, 10 June 1988, archives of the WCS.
[42] Ibid.

councils and bureaus was constantly being churned out. 'That meant that everything always turned out differently than you had been led to expect', says Wassenaar.

But who was really pulling the strings? 'The professors.' Wassenaar has no hesitation here. 'The research policy was made by the professors. They determined, officially through their membership of the research committee, which disciplines should get a bit more and which should get a bit less. And among those professors, of course, there was a certain pecking order. You had movers and shakers, men with authority. If they were highly respected within their own field, and had administrative savvy to boot, they were simply more powerful than others.'

'You mustn't forget that the Phytopathology Laboratory was an inter-university department', he continues. 'In times of financial cuts and changes, inter-university constructions always come off worst. Each university will be putting its own interests first. The team itself will be doing the same, but it will only succeed with tremendous powers of persuasion. Koen Verhoeff had that knack. When he left, no one else did. It was as simple as that.'

Verhoeff sighs. 'In 1985 the whole lab got together at Beekbergen', he recalls. 'A sort of meeting of minds, at which we discussed how things were going, the research, and what needed to happen. Molecular techniques would become more and more important, that much was clear. Without it, our research would become isolated.'

He falls silent. 'Baarn could never have stayed in Baarn', he says, finally. 'If you calculated what all that equipment would have cost, and the adjustments that would have been needed – remember that the Laboratory was in a residential area!… It was just *too much*. But it is easy to say that now, with the benefit of hindsight.'

A final word

On 27 June 1991, Villa Java closed for good as the Willie Commelin Scholten Phytopathology Laboratory. A small group of people raised their glasses one last time, in a toast to the future of the two research teams. For 'veterans', there was a garden party in the evening.

In the meantime, the inventory had been divided up. A library committee had taken stock of all the library's property, assessed it and assigned it to a new location. Furniture – provided it was still usable and in good condition – had been bundled into moving vans and driven to Amsterdam or Utrecht. The building and land had been valued and offered for sale on the property market. Only the new greenhouse – on which the team had once pinned their hopes

Closure of Villa Java, meeting of 27 June 1991. Reproduced by courtesy of Bob Schippers.

of their Laboratory's survival – was still the object of a legal battle between the board of the Foundation and Utrecht University.[43]

'It was a terrible time', recalls Schippers. 'Who was to go where, and when. I had to try and get the best possible solution for everyone – and in the meantime, the research was carrying on as normal. In terms of science we had reached the top – but inside our four walls there was a kind of asset stripping going on. Ghastly.'

'The interests did not run parallel, if I can put it like that', agrees Elgersma. 'Project team I went to Utrecht and team II went to Amsterdam. We had to be fitted into the faculty in Amsterdam and they had to be fitted into the faculty in Utrecht. At a certain point each team was negotiating with different people; we no longer had any shared interests. That soured the atmosphere. The research carried on, sure, but a mood of insecurity hung in the air.'

[43] The University offered to sell the greenhouse plus the land it was on to the Foundation for 750,000 guilders, which the Foundation considered an exorbitant sum. An amicable settlement was eventually reached in July 1992, archives of the WCS.

Before the split, the phytopathology department had possessed a research staff of 19 and 16 support staff: 17 attached to Utrecht University, 10 to the University of Amsterdam, 1 to the Free University and 7 'externally funded' staff.[44] After the move, these numbers shrank to 15 researchers and 14 support staff. Eventually, 19 survivors settled into their new offices at the Uithof complex in Utrecht, the remaining 10 moving into Anna's Hoeve in Amsterdam.

'The reorganization has been completed. The section has moved from Baarn to the faculty's headquarters on Kruislaan', the board of the biology faculty at the University of Amsterdam wrote to the executive board on 14 November 1991, 'and the staff have resumed their normal duties.'[45]

'For our research team, Baarn's closure was ultimately a blessing', says Schippers after a long silence. 'In Utrecht we were given all the facilities we needed. We should never have been split up, never. But if you look at everything that has been achieved in phytopathology in Utrecht … In personal terms it was a calamity, but in terms of science it was a brilliant move.'

44 Paid by BION, STW, municipal authorities or private companies.
45 File XII WCS, Maagdenhuis, UVA, DIV.

Epilogue

May 2005. Minuscule scars in the tree's trunk betray the site of last year's injection. Each elm is marked as a green dot on the land registry map of Pernis. Ten trees next to a car park on Deijffelbroekselaan, a lone elm near the football field a little further down the road, three more on the outskirts of the village, and six on a canalside near Willem Weysingel. A row of ducklings follow a mother duck in the water. The trees are in full leaf. Their green makes a sharp contrast with the clear blue sky.

The two tree surgeons work their way methodically down the row of green dots. One of them looks at the map in their van and points out the elms requiring treatment, while the other wields the injection pistol. The ritual is repeated each time afresh. As he walks towards his next patient, the tree surgeon scrutinizes its crown. When he reaches the tree, he thrusts the injection pistol into it with a short jabbing motion, at hip height. Rotating the pistol by 90 degrees, he pulls the trigger. He then withdraws it cleanly and chooses another injection site, about ten centimetres from the first. The process is repeated until the entire trunk has a circle of injections. Then the man cleans the hypodermic needle with a cloth drenched in disinfectant while walking towards the next tree and studying its crown. Meanwhile, his co-worker in the van ticks off the elms that have been treated.

The injection fluid is stored in giant test tubes in a refrigerator at the back of the van. The tubes contain a light blue translucent fluid with a suspension of a fungus, and have to be transported horizontally, explains one of the men. '*Verticillium*', he specifies, half turning and talking to me over his shoulder. 'We inject a suspension of *Verticillium*. It was prepared by the University of Amsterdam.'

On the way to Hoogvliet, the men stop at a small side road leading to some allotments. At one corner stands a gigantic elm, swaying in the wind. Its crown has bare patches, like a worn carpet. The trunk is overgrown with ivy. The elm is marked as a green dot on the map, but the men do not inject it. 'You have to be able to see the fluid being soaked up into the trunk', explains the tree-doctor. He peers up at the swaying crown. 'It is suffering from the wind here', he says, 'But it is not diseased.' He walks back to the van and makes a note on the map. 'The local authority will have to decide what to do with it. On the one hand, a lone tree is more vulnerable at a spot like this than in a lane. On the other hand, though, an oak would soon die here. At worst, the salty sea breeze will give the leaves a few brown edges. Elms are almost indestructible. Only elm disease – that's the only thing they can't fight off.' The men start up the van and carry on to the next elms marked on the map by the local authority.

'This is an incredibly busy time', says Thale Roosien, commercial manager at the tree service BTL Bomendienst BV.[1] The company's head office is in a small white building on an otherwise desolate industrial estate on the outskirts of Apeldoorn. This is where the vaccination programme is coordinated. 'It all has to be done between mid-May and the end of June – after the trees have come into leaf but before the elm bark beetles emerge. There are now about 40,000 elms around the country that have to be injected in that period. And if everything goes according to plan, there will be even more next year.'

Controlling elm disease, explains Roosien, is no longer a matter of theory but of practicalities. With the right phytosanitary organization, the disease pressure can be reduced to two or three per cent loss from disease. He sees elm disease as comparable to swine fever, foot and mouth disease, and bird flu. He shrugs. 'But *elms* – well. What do elms matter to the economy?'

Still, the disease is tackled in exactly the same way. Roosien rapidly reels off a number of set procedures: diseased trees are chopped down immediately, followed by regular monitoring of the surrounding area; root contact is severed in a row of trees to preserve the health of the rest (or if this cannot be done, healthy specimens are uprooted); and resistant trees are planted. And now a vaccine has come onto the market to prevent healthy trees from succumbing to disease.

'The vaccine came at exactly the right time', he says. 'When the Elm Disease Act [which had imposed a statutory obligation to report and uproot infected trees] was repealed in 1991, the disease was said to be under control. But everyone saw that the situation was rapidly deteriorating again. Understandable, since not every local authority prioritized the control of elm disease. And since not everyone was joining in, the disease continued to spread. The vaccine provided an important boost to motivate municipal authorities to make an effort to preserve their elms, especially where nothing had been done for many years. Using a combination of vaccination and phytosanitary measures, the disease could quickly be brought under control. And the costs are relatively easy to calculate.'

[1] Interview with T. Roosien, 31 May 2005.

At the end of the 1980s, BTL Bomendienst, then still part of the Land Development Society, had been approached by Doekle Elgersma and Ruud Scheffer of the Willie Commelin Scholten Phytopathology Laboratory, who wanted to know whether the Society was interested in joining them in experiments with what might prove to be a new remedy to control elm disease.

The collaboration led to the first small-scale inoculation of elms – starting with some 400 trees – around 1989. Under the watchful eye of scientists from the Phytopathology Laboratory and colleagues from the Plant Protection Service, staff of the Land Development Society had injected the suspension into healthy trees that were scheduled to be chopped down. The trees remained healthy. More tests followed, and a few years later, in April 1992, the company was licensed to market the product in the Netherlands.[2] The specific mutant of *Verticillium dahliae* (WCS 850) – the active ingredient of the bio-control vaccine that was registered as Dutch Trig – was assigned to the management and supervision of the Central Bureau for Fungal Cultures. But it was the Amsterdam research team that for many years supplied the fungal suspensions.

Viewed retrospectively, things moved incredibly fast. 'That was largely because experiments had been conducted with the vaccine for years before we started using it', explains Roosien. 'Its composition was known, and in over a hundred years this fungus had never been reported to have any adverse effect on humans or animals. What is more, the suspension as we used it was not atomized but injected directly into the tree. We knew that this would make it impossible for the fungus to spread into the surrounding area after being administered.'

The protective effect of Dutch Trig lasts for only one year. So if local authorities want to preserve their elms, they will have to set up an annual vaccination programme. 'It is up to the municipal authorities themselves', says Roosien. 'We try to convince them, of course, that our method is the simplest, most efficient way of limiting the natural pressure of disease. But if they choose to adopt different priorities – well, there's nothing we can do.'

At the same time, BTL Bomendienst has been expanding its market. In the United States, for instance, the company has been trying to get Dutch Trig licensed for almost ten years. 'The rules are incredibly strict there', sighs Roosien. 'They keep insisting on more and more new experiments. But the good news is that vaccinated trees are still remaining healthy. And if we do manage to get it licensed in the US too, we can expand its application considerably.'

[2] See also D.M. Elgersma, T. Roosien and R.J. Scheffer, 'Biological Control of Dutch Elm Disease by exploiting Resistance in the Host', in M.B. Sticlen and J.L. Sherald (ed.), *Dutch Elm Disease research: cellular and molecular approaches,* New York, Springer Verlag, 1993, pp. 188-192.

'Dutch Trig is a typical product of a joint effort involving scientists and industry', Roosien concludes. 'The Willie Commelin Scholten Institute provided the vaccine itself and the related expertise, and we professionalized the entire process. Right at the beginning, for instance, Elgersma and Scheffer were still working with a chisel and a pipette. Later on they moved on to a primitive sort of pistol. But if you have to inoculate hundreds of trees a day, you need a lightweight, efficient instrument that is based on sound ergonomic principles. So we now use a different type of injection pistol that we designed ourselves. But it's fair to say that the entire process started at the WCS.'

'Bio-control remedies will always account for a small proportion of the whole', says Kees van Loon. 'After all, they're relatively expensive, they have a highly specific effect, and you never know in advance how long they will work. With a few notable exceptions, they can hardly compete with chemical pesticides, which tend to be much more effective.'[3]

We are sitting in Van Loon's office, on the fourth floor of the Went Building at the Uithof complex of Utrecht University. Traffic roars down the motorway below. 'It still seems strange to me', Van Loon exclaims suddenly. 'Here we sit, high up above the natural world in a concrete tower block, surrounded by motorways. As biologists! But let's not get into that.'

Twelve years ago, Van Loon was appointed as full professor of phytopathology at Utrecht University, as the successor of Bob Schippers. The Phytopathology Laboratory in Baarn no longer existed – but in the concrete colossus at the Uithof a new, enthusiastic team of phytopathologists stood ready to take over the torch and hold it high.

Van Loon had spoken of the difference between chemical and biological remedies as soon as he arrived, in his inaugural address in 1993; he noted that chemical pesticides simply bypass the plant,[4] targeting the pathogen directly. The plant scarcely has to do anything to emerge protected. Biological crop protection agents work quite differently. They rely on the plant's innate capacity to actively fend off pathogens. Even highly sensitive plants have excellent defence mechanisms. 'Resistance is the rule, disease the exception!' he had repeatedly emphasized. The plant is resistant to its most common enemies, aside from the very small number that are unaffected by its defences.

In the natural scheme of things, he had told his audience, plants and pests naturally engage each other in a kind of arms race. All plants develop a number

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[3] Interview with L.C. van Loon, 6 October 2005.

[4] L.C. van Loon, *De plant tussen belagers en beschermers*, inaugural address given upon accepting the office of professor of phytopathology at Utrecht University on 7 October 1993.

of defence mechanisms over time. These are triggered as soon as the plant recognizes an enemy as an invader. That recognition, explained Van Loon, is specific and is almost always determined by a single resistance gene. He compares it to an alarm system: if a pathogen tries to 'break into' the plant, the 'alarm' goes off and the defences are mobilized. 'A clever pathogen will ensure that the alarm system does not recognize it as an intruder, or, if it does, that the system itself is deactivated. That is precisely what happens when a pathogen breaks through a resistance gene: as a result of a genetic alteration, the pathogen is invisible to the alarm system or prevents it from working.'[5]

Still using the analogy of an alarm system, Van Loon had then clarified the precise area he wanted to focus on. The system is attuned to two types of signals, he explained: the pest's signal (which triggers the alarm) and the plant's own signal, which activates its defence mechanisms. Fellow phytopathologist Pierre de Wit and his assistants at Wageningen had spent the last few years doing ground-breaking research into the molecular analysis of the pest's signal and possible ways of manipulating it. Their understanding of the plant's own signal was 'a lot more limited', but this was at least as important, if not more so: 'Once we know those signals, we can theoretically benefit from all defence mechanisms at the same time.'[6] And that was what he sought to achieve. 'Our attention could then shift from the expression of resistance to its induction.'

In this domain he was partly building on the inheritance passed down from Baarn, adds Van Loon. 'It's not as if we were starting from scratch.' The PhD students who had started their research in Baarn could simply complete it in Utrecht. At the same time, however, the former project team I from Baarn, together with some of Van Loon's new assistants, started on something new, in terms of research questions, technological culture, and research objects.

Partly at Van Loon's request, the executive board of Utrecht University and the board of the biology faculty had made an immense effort to offer the phytopathology project team the facilities it needed for modern research including the techniques of molecular biology. 'We acquired the capability for molecular techniques,' says Van Loon. 'And we started with a new experimental plant. That certainly produced a change of culture. There was no real break with the past, but the way we thought about and tackled things was completely different. It was as if we had turned a corner.'

Returning briefly to the relationship between chemical and biological pesticides: 'Biological pesticides are far more environmentally friendly. But what

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[5] Ibid., p. 9.

[6] Ibid., p. 11.

you see now', Van Loon concludes, 'is that the chemical pesticides industry is also making an effort to develop environmentally friendly products – partly because of the competition it faces from biological pesticides. So as things now stand, the main function of the companies producing biological remedies is to keep the chemical companies on their toes.'

Van Loon claims that for phytopathology in general – and this certainly applied, he insists, to the former Willie Commelin Scholten Phytopathology Laboratory – the accent has always been on research into the interaction between plant, pathogen and the surroundings, and that's where it will remain. That is the defining field of phytopathology, not the development and marketing of biological crop protectors, the cultivation of resistant crops, or other applications. But the history of the Phytopathology Laboratory only partly corroborates this view.

As far back as the late nineteenth century, opinions were divided concerning the Laboratory's objectives. To bulb-grower Krelage, the Laboratory was clearly an institute providing a service for the bulb trade, while Hugo de Vries wanted it to be a scientific laboratory. But it was under the leadership of its first director, Ritzema Bos, that the Laboratory eventually acquired a clear profile.

Until his departure, the Laboratory developed along two lines: as an independent science institute, where the director and his assistant explored the possible causes of new diseases and tried to find remedies to prevent or control them – and as a practical institute, to which farmers, horticulturalists, growers and teachers could address their questions about strange phenomena. This division was never as clear, however, as in the run-up to Ritzema Bos's actual departure and the quarrels that preceded it. Not until the choice had been defined in these terms could the board of the foundation decide the direction it wanted to go, a decision arrived at in the course of the discussions about the profile of the new director.

Yet notwithstanding the decisions that were made at that time, Westerdijk too allowed the Laboratory to grow in different directions. The *Mededeelingen* (Communications) give a good picture of the fundamental scientific research that she and her assistants carried out, and of the demands they expected it to meet (it had to build on earlier phytopathological research and preferably to contribute something new; it had to contain personal observations and to be experimental; and the results had to be reproducible and hence verifiable). In other words, in this period and under her leadership, phytopathology developed into a laboratory science (and could therefore, theoretically speaking, generate conclusions that were at odds with the everyday experience of farmers and horticulturalists, say, in a situation lacking the necessary controls), and into a discipline created by and for other phytopathologists. Westerdijk taught the fundamental principles of this new science at both the universities that had appointed her as an extraordinary (i.e. part-time) professor – so that she naturally helped to form a new group of professional phytopathologists, who in their turn had the capacity to redefine and watch over the limits of the discipline.

But Westerdijk never severed the Laboratory's ties with farmers, horticulturalists and growers – that is, society in general. The history of research into elm disease demonstrates better than anything else that under her leadership the Phytopathology Laboratory fulfilled a variety of roles: scientific, practical and cultural. Scientific, because Westerdijk and some of her PhD students and assistants studied and established the cause of the disease, practical, because some of those working at the Phytopathology Laboratory spent many years searching for resistant trees, and cultural, because it is no coincidence that the pioneering work in the research on elm disease is attributed to seven Dutch women.[7]

Besides knowledge, the Phytopathology Laboratory was always involved in producing 'knowledge carriers' or experts: and never before – or since – has such a high proportion of female PhD students and assistants been attached to an institute of biological science in the Netherlands as during Westerdijk's term as director of the Willie Commelin Scholten Phytopathology Laboratory in Baarn. The Laboratory was then a relatively safe, protected research haven, which afforded ample scope for young biologists seeking to develop their expertise in phytopathology. But it was Westerdijk who set the tone there, in the most literal sense of the word. Even today, she still stands as a role model for many of the women who once worked under her (as cheap labour), whether as PhD students, assistants or visiting scientists.

It is as if with the combination of 'elm disease' and 'women', Westerdijk established the profile of the Phytopathology Laboratory once and for all. After all, elm disease was a disease that for large swathes of the population was visible and alarming – it attracted public concern – and thanks to the efforts of the women in Baarn, much of the mystery of this disease was dispelled. The American Phytopathological Society went so far as to issue T-shirts (in Westerdijk's size) with the names of the seven women and a number of photographs under the text in bold: 'Pioneers in Plant Pathology'.

But to equate the Phytopathology Laboratory with women and elm disease would scarcely do justice to the institute's diversity. Male researchers too, in

[7] E.g. in F.W. Holmes and H.M. Heybroek, *Dutch Elm Disease: The Early Papers, Selected Works of Seven Dutch Women Phytopathologists*, APS Press, 1990.

Wageningen as well as Baarn, played an important part in demystifying the transmission, spread and diagnosis of the disease. And the rich history of the Phytopathology Laboratory embraces far more than diseased elms alone.

The developments following the Second World War, in particular, clarify just how much deeper and multi-faceted phytopathology research became. Under the leadership of Louise Kerling, the Laboratory not only grew in size, but acquired a larger staff and a burgeoning number of new sub-disciplines. Building on the work done before the war by Van Luyk, separate fields emerged, focusing on subjects such as the phyllosphere, rhizosphere, vascular parasitism, and viruses. There was still a link with 'real world' of growers, but now, for the first time this link was questioned, under increasing pressure from the universities.

If one were to pinpoint a particular time when research on the interaction between plant, pathogen and surroundings shifted to centre stage in the Phytopathology Laboratory's concerns, it would be during Kerling's term as director. This shift was in part an autonomous development: ever-increasing specialization is a general trend in scientific development. But in part it was also fuelled by external factors: more and more new technological developments made it possible to conduct ever more detailed and more specialized research, while the explosive expansion of science in general made a division of labour and specialization imperative. At the same time, the scientistic climate in society imposed ever more stringent demands on the capacity of science and technology to deliver solutions, which in turn led to more in-depth research. Costs spiralled sky-high. A corollary of this was that the Phytopathology Laboratory became dependent on the universities for its financing, and therefore for its existence, and was obliged to meet their demands. The success of the old policy of 'splendid isolation' – inasmuch as this was ever actually pursued as a deliberate strategy – appeared to be nearing its end.

With the advent of Koen Verhoeff as director, external controlling influences became an unmistakable presence. Fundamental scientific research into the interaction between plant, pathogen and the surroundings was still the Laboratory's central concern, but the government and external financiers increasingly determined the lines of enquiry that were pursued. These were not confined to fundamental science: a growing concern for the environment spawned a demand for biological methods of crop protection. Collaboration – at national and international level, within and between disciplines, with agriculture and industry – was a new imperative, and one that policy-makers expected, given the effort they invested in it, to yield great results.

Completely at cross-purposes with this was another new trend. By the early 1980s molecular biology had outgrown its infancy, and the latest techniques promised to be capable of solving old problems, including burning issues in phytopathology. This required a fresh wave of investment: from financial to cognitive, from social to material. And with molecular biology came new parameters – cooperative frameworks shifted, questions changed, and new colleagues presented themselves.

Although molecular biology relies on a fundamentally different paradigm than phytopathology – it not only uses different terms and techniques, but has a different vantage point as well – the gap between the two has narrowed. This is clear from the history of Verhoeff's succession. The University of Amsterdam's initial advertisement was for a phytopathologist to continue the research in an ecological direction. But after two years of recruitment and interviews, it concluded that there was no suitable candidate, and so decided to alter the profile. In 1992 it finally settled on Dr Ben Cornelissen as its nominee for the vacancy; but Cornelissen, as he immediately says himself, is not a phytopathologist. He was trained and specialized as a molecular biologist. Apparently the Phytopathology Laboratory's heritage, or Amsterdam's portion of it, could safely be entrusted to molecular biology – without the need for any adjustment in the title of the chair.

Will phytopathology eventually disappear as a separate discipline? That depends on the definition of the field. The history of the Phytopathology Laboratory reveals a succession of changes in this definition, and there is no need to be narrowly specific. In spite of closures and moves, directors coming and going, and changes in universities and boards, phytopathology as a discipline is flexible enough to endure through shifting contexts and cooperative frameworks. The Willie Commelin Scholten Phytopathology Laboratory, however, is no more.

I decided to visit the different sites where the Laboratory might have left its traces – starting in Amsterdam. The façade of the splendid mansion at Roemer Visscherstraat 1 is unchanged. The district is still one of the most expensive and most fashionable in the city. But even here, the advance of modern mass tourism is visible in the newly renovated street. Where the façades once marked the dividing line between public and private space, today, inquisitive visitors can pass through to the interior of a remarkable large number of buildings. A well-filled wallet or credit card will suffice. The former Laboratory is among those accessible to visitors – it is now the Owl Hotel.

The hotel is dark and a musty smell hangs in the air. In the downstairs corridor, leading to what is now the breakfast-room, hang old drawings of the house from which one can infer what it originally looked like. The receptionist joins me to look at them. 'A laboratory of whatter?' she splutters, eyebrows shooting upwards.

She gives me the key to room 46, at the rear of the hotel. A small lift takes me up. What was once a single large space has been divided into numerous small rooms and a corridor. But the view is unchanged. To my great surprise, the rear rooms of the Owl Hotel still overlook the greenhouses and garden that Commelin Scholten once had built for his only son. Cyclists and joggers in the Vondelpark heedlessly cycle and jog past them. Nothing recalls their poignant past – there they lie, as if nothing has changed in all those years.

At the corner of Roemer Visscherstraat and Tesselschadestraat, I spot a large plaque bricked into the blank wall at the end of the street. Its inscription translates as: 'In this house lived and worked Dr Aletta Jacobs. She was the first woman to be awarded a doctorate at a Dutch university. She paved the way for those who came after her. The women of future generations owe her a debt of gratitude.' Not a word about the woman in the neighbouring building who had the honour of being the Netherlands' first woman professor.

Resuming my journey, I drive to Javalaan, Baarn. In the former surroundings of the Laboratory, a surprising number of old colonial villas are still standing, apparently intact. Outwardly the area looks a great deal like the old photographs from the Phytopathology Laboratory's archives; Javalaan is still a wide, tree-lined avenue, with parks and lawns all around. But Villa Java has gone. Where the Laboratory once stood, there is now a cumbersome, pyramid-like structure erected in dark brown brick – to my astonishment also called Villa Java. From the rooftop, terraces are laid out in layers like irrigated rice paddies on a hillside. Pot plants and balcony hedges show the presence of residents.

From the new Villa Java, a muddy path leads to the grounds around the Central Bureau of Fungal Cultures, the building itself now abandoned and overgrown. Some of the windows have been smashed and the once white paint is grey and peeling. The garden has been deserted and is full of rubbish. Five years ago, the staff and fungi of the CBS moved to new premises on the Uithof campus in Utrecht. Together with the Netherlands Institute for Developmental Biology they now inhabit an ultra-modern research complex that operates under the auspices of the Royal Netherlands Academy of Arts and Sciences.

Only the former coach-house 'Madoera' seems still to be intact. Hidden from view by the pyramidal apartment block, it stands behind a row of large bushes and a low cast-iron fence. Some kind of spiritual society seems to have moved in; visitors by appointment only.

A short brick path leads to the large stone façade. The inscription is moss-grown and partly eroded, and the text is scarcely legible. But those who know what to look for and are determined to find it can still make out the words of Westerdijk's motto, 'Werken en feesten vormt schone geesten' ('For fine minds, the art is / To mix work and parties'). This is one of the last tangible memorials to the Willie Commelin Scholten Phytopathology Laboratory, along with the plaque that was installed with a brief ceremony in the main hall of the residential pyramid Villa Java. But that is accessible only to the residents themselves and their guests; there is nothing at all to be seen from the street.

I have one more place to visit that is connected to the Laboratory's history. I leave Baarn and drive to Heemstede. The road winds through dunes and woods, passing a few opulent mansions nestling grandly in their natural surroundings, shielded from the menacing outside world by thick walls and iron fences.

My destination today is on the outskirts of Heemstede, in the General and Catholic Cemetery. A large door in the whitewashed wall swings open to provide access to the graveyard. A respectful silence reigns within, broken only by the rustling of trees and the sporadic chirping of birds. Gravestones and headstones are visible on both sides of a branching gravel path. In front of the intersection where the path divides into the main and side avenues leading to the graves stands a large shelter with a map and a register of names.

But the name of Scholten does not appear. Nor can I find any Commelins. Running my finger down the list again, more slowly, I pause at the name H.H. Crommelin – buried here on 28 November 1917, grave number E – I – 033. That must be Willie's mother.

Braving the icy wind I locate the 'E – I' section and walk around it several times before discerning a weather-beaten little sign with the barely legible number 033. But there is no longer a gravestone – neither for number 033 nor for the neighbouring number 034, or whatever it may be. The only vegetation growing on this little plot of land is some hard, yellowish grass. The graves must have been visibly divided at one time, but these marks too have vanished. A bumpy, barren space is all that remains.

A telephone call to the manager of the cemetery finally clarifies the omissions. The Commelin family – the manager apologizes for the misspelling 'Crommelin' in the register – once purchased two adjoining family graves here to be maintained in perpetuity. In one were buried, successively, Catharina Cornelia Ouwersloot (in 1878), Johannes Commelin (in 1882), and Caspar Willem Reinhard Scholten (in 1914) – and in the other H. Ouwersloot (in 1845), Johannes Scholten (in 1872), Caspar Willem Reinhard Commelin Scholten (in 1893) and Hendrina Hermina Commelin (in 1917).

In other words, Willie's father shares a grave with his parents-in-law in one grave, and Willie rests in the other with his maternal great-grandmother, his paternal grandfather and his mother. After all these burials were complete, both graves were sealed up permanently. With Willie's death, this Commelin line of the family too came to an end. In accordance with the provisions of the deed of purchase of this plot, the remains have never been disturbed.

But what about the gravestones? The manager leafs through his papers, and then explains. No one had ever tended them. They became dilapidated and weather-beaten, and eventually fell over. After a few decades, when it became apparent that no one was responsible for them, they were finally removed, on 24 February 1965.

Acknowledgements

After the sale of its buildings and grounds in 1994, the Willie Commelin Scholten Phytopathology Laboratory Foundation had a fund at its disposal with which it could pursue its objectives along different channels. Modifying its name in December 1995 to the Willie Commelin Scholten Foundation for Phytopathology, it set itself the new goal of promoting phytopathology by supporting research and university education in the field. This book was conceived by the Willie Commelin Scholten Foundation for Phytopathology and produced at its expense.

At its meeting of 12 July 2000, the Foundation's board decided to publish a history of the Laboratory, including its impact on university research. On 1 September 2002, I was seconded to Utrecht University for this purpose, as a temporary, part-time researcher.

The Foundation wanted to produce a book that would be accessible to interested lay readers as well as to phytopathologists and science historians. Jargon and technical terms have therefore been avoided as much as possible. In addition, there has been no attempt to bring nomenclature up to date. The past names and taxonomic classification of organisms have been retained, even in cases in which later phytopathologists have adopted different ones. The same applies to a number of terms from phytopathology; these too have been reproduced as used at the time, even if they later fell into disuse or acquired a slightly different meaning. The correct meaning is generally clear from the context.

The Phytopathology Laboratory has a history reaching back almost a hundred years. Any reconstruction will obviously be incomplete. Not all the research conducted there is discussed in detail here. Nor is it possible to mention the names and specializations of all the researchers who worked there – this applies most notably to the many visiting scientists. To do justice to at least one category of researchers that remained stable over the years, it was decided to include an appendix listing all the PhD theses that were prepared in the Laboratory.

Rather than stalking comprehensiveness, the aim has been to provide a representative picture. The focus is on examples that are typical of the type of research and the type of questions that were key to the different periods in the Laboratory's history. This places the emphasis squarely on important shifts within phytopathological research, and the dynamics behind them, rather than on an overview of all the questions with which phytopathologists concerned themselves in a time span of almost a century. Anyone who is interested in a more detailed overview of the research in a particular subject can consult the original publications in the various biology journals.

This approach illuminates the way in which the new field developed, among other things by the stands it took in relation to other disciplines, social trends, and changes in the university climate in the course of the twentieth century. The emphasis here is on contingency: there was no pre-existing blueprint for the development of research in plant pathology – the entire history is the result of a succession of choices, which, once made and translated into research, were in due course questioned and sometimes reversed. No *a priori* assumptions have been made here about the factors that determined these choices. This explains why the factor gender, for instance, is not used systematically in this book to reconstruct the historical developments at the Phytopathology Laboratory, however clearly this category stands out, given the shifting balance of power between the sexes at the Laboratory.

Over the years, the archives relating to the history of the Willie Commelin Scholten Phytopathology Laboratory have become dispersed among several locations. In preparing this book, I relied on archives originating from the former Villa Java in Baarn. These 'WCS archives', as they are now known, have been placed in the care of the National Archives for North Holland in Haarlem, where they are being opened up for the benefit of future research. Some of the archives originally kept in Baarn were moved to the International Information Centre and Archives for the Women's Movement in Amsterdam in the 1980s.

To gain an understanding of events in recent history, interviews were conducted with people who were involved in the Phytopathological Laboratory in Baarn at various times. The presentations of these interviews here have all been authorized by those concerned. My other sources included documents in the public domain administered by the Municipal Archives of Apeldoorn, Arnhem, Amsterdam and Haarlem; the National Archives in The Hague; the Archives of the Royal General Bulbgrowers' Association in Hillegom; the University Museum of Utrecht University; Utrecht Archives; Amsterdam University Museum 'De Agnietenkapel'; the archives of Museum Boerhaave in Leiden; the University Library of the University of Amsterdam, and the library of the Anna's Hoeve Biology Centre of the University of Amsterdam.

To gain access to confidential documents from the wartime conduct files (*zuiveringsdossiers*) of the University of Amsterdam and Utrecht University, as well as personal information filed by the administrative centre of the University of Amsterdam, consent was requested and obtained from the competent authorities. The texts based on this material have also received the proper authorization.

A scientific advisory committee was set up for this project, consisting of Dr Nyckle Fokkema, Professor Bob Schippers (chapters 1 to 6), Professor Rob Visser, and Professor Jan Carel Zadoks. I should like to thank them for their dedication and intense commitment.

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Fortunately, the board of the Willie Commelin Scholten Foundation for Phytopathology decided that the best way to produce an English version of the original Dutch text would be to enlist the services of a qualified translator. In Beverley Jackson, it made an excellent choice. I should like to extend my sincere thanks to her, too, for the constructive working relationship that we built up.

In conclusion, it must be added that the responsibility for this text lies exclusively with the author.

Patricia Faasse, August 2007

Table of terms and abbreviations

BCAH	Biologisch Centrum Anna's Hoeve van de Universiteit van Amsterdam *Anna's Hoeve Biology Centre of the University of Amsterdam*
Bestuur WCS	Bestuur Stichting Willie Commelin Scholten *Board of the* WCS *Foundation*
BION	Stichting Biologisch Onderzoek Nederland *Foundation for Fundamental Biological Research*
BZ	Ministerie van Binnenlandse Zaken *Ministry of the Interior*
CB	College van Bestuur *Executive Board*
CBS	Centraal Bureau voor Schimmelcultures *Central Bureau of Fungal Cultures*
CC	College van Curatoren *Board of Governors (of the University)*
CHZRU	College tot Herstel en Zuivering van de Rijksuniversiteit Utrecht *Committee for the Restoration and Purification of Utrecht University*
CIBBI	Comité inzake Bestudeering en Bestrijding van de Iepenziekte *Committee for the Study and Control of Elm Disease*
DIV	afdeling Documentaire Informatie Voorziening *Documentary Information Services*
DOO	Dienst Onderwijs en Onderzoek *Education and Research Service*
DRBS	*Deleterious Rhizobacteria*
FWN	Faculteit Wis- en Natuurkunde *Faculty of mathematics and physics*
GAA	Gemeente-archief van Amsterdam *Amsterdam Municipal Archives*
GAH	Gemeente-archief van Haarlem *Haarlem Municipal Archives*
GR	Gemeenteraad *City Council*
HBS	Hogere Burgerschool *Modern-style secondary school*
IIAV	Internationaal Informatiecentrum en Archief voor de Vrouwenbeweging *International Information Centre and Archives for the Women's Movement*

IPO	Instituut voor Plantenziektenkundig Onderzoek *Institute of Phytopathological Research*
ITBON	Instituut voor Toegepast Biologisch Onderzoek in de Natuur *Institute for Applied Biological Research in the Natural Environment*
IVT	Instituut voor Tuinbouwveredeling *Institute for Horticultural Plant Breeding*
KAVB	Koninklijke Algemeene Vereeniging voor Bloembollen-cultuur *Royal General Bulbgrowers' Association*
KAW	Koninklijke Akademie van Wetenschappen *Royal Academy of Arts and Sciences*
KB	Koninklijk Besluit *Royal Decree*
KI (KIT)	Koloniaal Instituut (now Koninklijk Instituut voor de Tropen) *Colonial Institute (Now Royal Tropical Institute)*
KNAW	Koninklijke Nederlandse Akademie van Wetenschappen *Royal Netherlands Academy of Arts and Sciences*
KNHM	Koninklijke Nederlandsche Heidemaatschappij *Royal Netherlands Land Development Society*
KNTML	Koninklijke Nederlandsche Tuinbouw-Maatschappij Linnaeus *Linnaeus Royal Netherlands Horticultural Society*
MB	Museum Boerhaave *Museum Boerhaave*
MPLWCS	Mededeelingen uit het Phytopathologisch Laboratorium Willie Commelin Scholten *Communications of the WCS Phytopathology Laboratory*
MRHLTB	Mededeelingen der Rijks Hoogere Land-Tuin en Boschbouwschool *Communications of the State Institute of Agriculture, Horticulture and Silviculture*
NA	Nationaal Archief *National Archives*
NHM	Nederlandsche Heidemaatschappij *Netherlands Land Development Society*
NIBI	Nederlands Instituut voor Biologen *Netherlands Institute of Biology*
NJPP	*Netherlands Journal of Plant Pathology*
NRLO	Nationale Raad voor Landbouwkundig Onderzoek *National Council for Agriculture Research*
NSB	Nationaal-Socialistische Beweging in Nederland *National Socialist Movement*
NSDAP	Nationalsozialistische Deutsche Arbeiterpartei *National Socialist German Workers' Party*
NWCS	Notulenboek WCS *Minutes of the* WCS *Foundation's meetings*
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek *Netherlands Organization for Scientific Research*
PD	Phytopathologische Dienst *Plant Protection Service*
RANH	Rijksarchief in Noord Holland *National Archives in North Holland*

SB	Sectie biologie *Biology section*
STW	Stichting Technische Wetenschappen *Technology Foundation STW*
TNO	Nederlandse Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek *Netherlands Organization for Applied Scientific Research*
TP	Tijdschrift over Plantenziekten *Journal of Plant Pathology*
UA	Het Utrechts Archief *Utrecht Archives*
UU	Universiteit van Utrecht *Utrecht University*
UVA	(Gemeentelijke) Universiteit van Amsterdam *(Municipal) University of Amsterdam*
VU	Vrije Universiteit *Free University*
WCS	(Stichting) Willie Commelin Scholten *Willie Commelin Scholten (Foundation)*
WCVV	Wetenschappelijke Commissie voor advies en onderzoek in het belang van de Volkswelvaart en Volks-weerbaarheid *Research and Advisory Committee for Public Welfare and National Defence*
WJPLWCS	Wetenschappelijk Jaarverslag van het Phytopathologisch Laboratorium Willie Commelin Scholten *Scientific annual report of the WCS Phytopathology Laboratory*
WUB	Wet Universitaire Bestuursvorming *University Administration Act*
ZWO	Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek *Netherlands Organization for the Advancement of Pure Research*

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Appendix PhD theses

* = research not conducted at the Phytopathology Laboratory

To illustrate the relatively large number of women researchers at the Laboratory, especially in its early years, the following table differentiates betwen men (m) and women (f).

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