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Only nursing plants?

Kessler, P.J.A.

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Hortus botanicus Leiden

Prof.dr. Paul J.A. Keßler

Only nursing plants?



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Discover the world at Leiden University

Hortus botanicus Leiden

Only nursing plants?

Inaugural lecture by

Prof.dr. Paul J.A. Keßler

on the acceptance of his position as professor of
Botanical Gardens and Botany of South East Asia
at the Universiteit Leiden
on behalf of the Leids Universiteits Fonds
on Friday April 21, 2017.



**Universiteit
Leiden**

Respected Rector Magnificus, members of the Leiden University Fund (LUF) Board, members of the Curatorium of this special Chair, distinguished Colleagues and Guests,

Hortus	Horti
Horti	Hortorum
Horto	Hortis
Hortum	Hortos
Horto	Hortis
Horte	Horti

This is the declination of the Latin noun Hortus, which translates to the English word ‘garden’.

The term *Hortus botanicus* should therefore be translated as ‘botanical or botanic garden’.

The definition of this term in the International Agenda for Botanic Gardens in Conservation (2012) reads as follows:

‘Botanic gardens are institutions holding documented collections of living plants for the purpose of scientific research, conservation, display and education.’¹

Hence the additional meaning: Our Hortus botanicus Leiden is no public park or pleasure garden, but is, in fact, a real botanical garden.

As staff at the Leiden University academic garden, we have adapted the above definition a little and refer – in short form – to three fields in which we are developing our activities:

- 1. Research**
- 2. (Higher) education**
- 3. Public outreach**

Since 1590, we at the Hortus botanicus have maintained living plant collections for these purposes, for use at Leiden University, and all three areas have been a part of our mandate since the inception of the Garden. This includes public outreach, which was implemented from the very beginning, as depicted in some 17th-century images of women visiting our Hortus. They were certainly not students, since women were not allowed to study in those days. The oldest academic garden in Western Europe was not the exclusive domain of students and scientists – from its earliest days, the Hortus also welcomed visitors to study and enjoy our museum’s vibrant, living collection.² We can therefore claim to be the oldest museum in the Netherlands, contrary to other sources that state it is Teylers Museum in Haarlem.

I would like to first present a short historical outline of the Garden’s plant- and botany-related activities with respect to the flora of Southeast Asia.

I shall then elaborate on the role of our own Hortus today, and outline a vision of future research, education and outreach activities.

Historical outline

The drawings and lists of plants in our early garden, which remain preserved in the Leiden University Library to this day, reveal that not only medicinal plants, but many different species that the first prefect, Clusius, and the first hortulanus, Cluyt, could lay their hands on were cultivated in the garden... so this was not, strictly speaking, a Hortus medicus, but a genuine Hortus botanicus. Then, as now, the garden was used for research and (higher) education.

Botanical studies on tropical plants have been carried out since the Hortus botanicus Leiden was founded. All plants reaching European shores were new to science at the time, and people were excited over their exotic appearance, as well as the

potential uses of these previously unheard-of species and their underlying stories.

This mania for collecting plants resulted in the creation of many herbaria and living collections originally intended for scientific documentation of comparative species material – not specimens, as the concept of evolution had not yet entered the natural sciences arena. Species were described and depicted in drawings, as photography was not available, and the collections were used as a dry or living database. Since living tropical plants could not be grown in European gardens in those days because the climate of origin could not be replicated, the pressure to establish herbaria in botanical gardens – a combination still in existence today – was increased. Famous current examples of this combination are Kew Gardens, the Missouri Botanical Garden, Botanischer Garten und Botanisches Museum Berlin-Dahlem, Singapore Botanic Gardens and Botanic Garden Meise.

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At the dawn of the Golden Age, when the Dutch had become wealthy through the trade of spices, Carolus Clusius, the first prefect, asked the Dutch East India Company (VOC) to collect branches – bearing leaves, flowers and fruits – of nutmeg, cinnamon, black pepper and other strange plants. Those were, of course, herbarium specimens that were exhibited at that time with strange animals, including ‘drakes’, and minerals in the Ambulacrum.

Paul Hermann, appointed prefect of the Hortus in 1677, brought in large collections of plants and animals from Sri Lanka and other countries, and described them in his catalogue *Musaeum Zeylanicum*.³ These included a camphor tree and a cinnamon tree – new species added to the living collections.

Brugmans (1763-1819), a very dynamic director, had already referred to a few Southeast Asian taxa – *Jasminum sambac*,

Musa paradisiaca, *Melia azaederach* and *Epidendron sinense* – in his *Elenchus plantarum*⁴. He reorganised the collections and rearranged the academic programme.

With the appointment of Reinwardt as director of the Hortus botanicus in 1823, the living collection of Eastern origins increased substantially. His 1831 list included 5,600 species and varieties – almost 600 more than in 1822.⁵ This was due to Reinwardt’s interest, especially in Indonesian flora, as he had been appointed founding director of ‘s Lands Plantentuin te Bogor’, known today as ‘Kebun Raya Bogor’. He arrived in Batavia, now Jakarta, in 1816, and on May 18, 1817, the Dutch government approved his plans to establish a new botanical garden in Buitenzorg. This explains the recent strengthening of bonds in common research activities between the Hortus Leiden and Kebun Raya Bogor, and this year’s joint exhibitions and symposia in celebration of the bicentenary.

Reinwardt made several trips to Indonesia, especially Java, the Moluccas, Timor and Sulawesi, in order to collect species. Within five years, he was able to gather more than 900 species with economic potential for cultivation, as the garden in Buitenzorg was intended to serve as a major research centre for agriculture and horticulture. Many duplicate plants were sent to the Hortus in Leiden – unfortunately, only a few survived the journey from Indonesia to the Netherlands due to the long and harsh conditions during the travel.

In 1838, the German lawyer Friedrich Karl von Strombeck wrote the following in his travel book:

„Ich möchte glauben, dass man nirgends besser als zu Leyden die Naturwissenschaften studiren könne; denn auch der Pflanzgarten, ganz in der Nähe der Universitätsgebäude, ist von einer Vollständigkeit, besonders hinsichtlich der indischen Gewächse, dass er mit jedem Institute dieser Art in Europa gewiss wetteifern kann.“

‘I believe that one cannot study Natural sciences better than in Leiden, because the garden located near the University buildings is so complete – especially its holdings of Indonesian plants – that it can rival all other institutes of this type in Europe.’⁶

At the beginning of the 19th century, German scholar Philipp Franz Balthasar von Siebold had an immense influence on the cultivation in the Netherlands of ornamental plants from the east. He introduced a large number of Japanese plants to Europe, initially through our Garden and later through his own nursery. This exceptional man made twofold use of these newly discovered plants: to describe and preserve them for future generations in his publication *Flora Japonica*, or in the herbarium specimens now housed in Naturalis, as well as to inspire people to grow them in their own gardens.⁷ Did you know that we enjoy many of our garden plants – including Hortensia, Hosta and Japanese Anemone – because von Siebold imported the first specimens into this country?

The prefects and their students were not the only ones interested in publishing works on the Hortus living collections. The hortulanus Heinrich Witte was responsible for the living collections between 1855 and 1898. Favourite plant groups included palms, orchids, bromeliads and succulent plants that were the subject of catalogues he printed and articles he wrote for various journals.

Tropical plants arrived early in the Garden’s history. To ensure their survival, a special area in front of a south wall was excavated and screened off with reed mats. Braziers were placed in the pits, although the sun was the major source of heat. In the 19th century, individual glasshouses were built in the Victorian style; unfortunately, none of them has survived.⁸ Our current glasshouses were built in 1937 and renovated in 2013. They now house our scientifically important collections

of Southeast Asian orchids, *Nepenthes* (pitcher plants), ant plants, ferns and much more.

Baas Beeking, prefect from 1931 to 1939, who might be remembered in Leiden for his interest in the history of the garden – including the first reconstruction of the Clusius garden – also initiated the construction of our tropical glasshouses, which were opened in 1938. The various individual glasshouses were then torn down and a single complex with a special Victoria house was made available.

The appointment of Van Steenis as professor of Tropical Botany and Plant Geography in 1951 brought a major boost to Southeast Asian botany in Leiden. He was co-founder of the Flora Malesiana Foundation and his objective was to inventory and describe all plant species in Southeast Asia. A number of expeditions were then organised, resulting in the collection of thousands of herbarium specimens as well as living collections for the Hortus. These collections were and are the basis of research activities and scientific publications carried out by either the National Herbarium of the Netherlands (now a department of the Naturalis Biodiversity Centre) or our own botanical garden.

The merger of the herbarium with Naturalis, while our Garden remained a part of Leiden University a few years ago, naturally prompted the question of a vision for botanic gardens worldwide and the role of our Hortus botanicus Leiden in the near future.

The last ten years have seen some weighty discussions, in many European countries, on the relevance and necessity of operating and supporting botanical gardens, especially those associated with universities. The outcome was unfortunately quite negative and has led, for example, to closure of the only university botanic garden in the province of Saarland, Germany. In the Netherlands too, several academic gardens

were dissociated from their original universities and are now run by foundations with almost no interest in research or higher education.

This stands in contrast to several other countries, especially those located along the equator. Indonesia, as an example, has started to develop several new gardens on its various islands, and therefore does not depend on four fully-fledged horti on Java and Bali. Even Universitas Indonesia in Jakarta is preparing a new garden on its Depok campus, for which it has sought our advice.

The latter developments have encouraged the garden community to start a discussion of the importance and relevance of botanic gardens in many, many countries worldwide. This is also reflected in the theme of our next Global Botanic Gardens Congress, to be held in Geneva in June: 'Botanic Gardens in society: Visions for the future'. Paul Smith, Secretary General of Botanic Gardens Conservation International (BGCI), recently provoked a discussion with his Guest Essay in *Sibbaldia* He proposes 'Building a global system for the conservation of all plant diversity: A vision for botanic gardens and Botanic Gardens Conservation International'.⁹

This is, unfortunately or fortunately, not the only objective of a botanic garden, as Smith (2016) states in the same article:

'Botanic gardens are a diverse community fulfilling multiple objectives, including attracting visitors, public education, scientific research, horticulture and conservation.'

This diverse range of tasks and responsibilities therefore makes it difficult, in my view, for directors or boards to choose a focus and clarify and promote the goals and significance for society, as it depends on the situation of individual gardens located on various continents, and in various countries and localities.

The Hortus botanicus Leiden, staffed with a team of professionals, recognises these challenges and is prepared to face them.

As you have heard before, our Garden's existence dates back more than 427 years, as part of Leiden University, and we assume, given the fantastic results over the past few years, that it will thrive and even grow the next half-century!

What can we offer in the three fields -research, higher education and public outreach – over the next decade?

1. Research

Scientific collections – resources from and about the natural world – are primary objects for discovering and understanding species diversity in a region, and reveal evolutionary developments. Additionally, they are the backbone of ex situ conservation and management of plant diversity. Our living collections in the Hortus' glasshouses focus on Southeast Asian plants such as orchids, carnivorous plants such as *Nepenthes* (pitcher plants), ferns, *Dischidia*, *Hoya* and a number of other taxa. Many of them are collected in the wild, which has made these specimens extremely valuable research objects for the understanding of Southeast Asian plant diversity. More than 80 species of orchids new to sciences have been identified in our own collections, including specialities such as the night flowering *Bulbophyllum nocturnum*, *Dendrobium goodallianum* or *Chelonistele maximae-reginae*, named after our queen.

For our research activities, we recently invested in a new database system that enables registration, administration and tracking of our living collection. Many people may consider this programme a toy for the spoiled collection manager who seeks to impress his or her colleagues with the newest gadget.

In truth, we need to collect this information in our system so that we can answer important questions such as:

How many species do we grow in our garden?

- Is the gene pool of our limited number of specimens large enough to let rare species survive ex situ?
- Which cultivated species are threatened and do we have enough specimens on hand to prevent species extinction?
- Does our Garden have a back-up (shadow collection) of our important collections?
- How do we reduce the risk of our invaluable scientific collections being prone to attacks by viruses, bacteria, fungi or even thieves?
- I would like to demonstrate this issue for one of our focus collections: the pitcher plants.

Nepenthes is a genus of about 140 species concentrated in the Malay Archipelago, with minor extensions in Madagascar, Northern India, Sri Lanka, Laos, Cambodia, Vietnam, Thailand and pockets of Australia.¹⁰ Species of this genus are among the most vulnerable plants in the world and many of them are categorised as vulnerable, endangered or even critically endangered, according to the IUCN Red lists of Threatened species.¹¹ Specimens of several species are cultivated in many botanical gardens and in amateur collections, but we actually do not know if this family is protected ex situ. Out of the known 140 species, the Hortus cultivates about 90 in 300 different accessions and about 600 individuals. A preliminary study shows that our sister gardens often did not register the origins of their collections, the sex of the individual plants or how many specimens of each sex are necessary to ensure the genetic diversity is covered ex

situ. For some species, the male-female ratio in the wild is 7 to 1, seemingly because a large amount of pollen is necessary to effectively pollinate the females. The garden community certainly has no idea whether we are maintaining this ratio and of course we will change this in future.

As a second example, I would like to briefly discuss the work of one of my PhD students, Roderick Bouman. He is currently studying the tropical and subtropical genus *Phyllanthus* (Phyllanthaceae), a complex of more than 600 species which he seeks to unravel and for which a number of modern methods are required to be used in order to obtain the results.

Fortunately, we live in the 21st century, a hallmark of which is the production and analysis of vast amounts of varied data. Technical revolutions are observed within the molecular field, among others, and in the analysis of big data in genomics, proteomics, transcriptomics or metabolomics. Only small amounts of biological material are necessary for the analysis of secondary metabolites and, of course, we hope to detect substances which will lead to new medicines. To understand all of these data, we need bioinformatics, an interdisciplinary field combining computer science, statistics, mathematics and engineering, which develops methods and software.

All these techniques enable the detection of genetic diversity and evolutionary processes in those large genera, and better evaluation of genetic factors for species conservation, among other functions. They lead to new classifications of the plant kingdom or help detect broad patterns such as the distribution of plant species throughout the world. An increasing amount of information about the threat level to habitats and individual plants and animal species is also available.

New forms of communication have also enabled us to establish varied and extensive networks of either institutions or scientists, and students, who want to study Southeast Asian

plant diversity. The botanic gardens, with their highly qualified staff, can play an important role in this process.

2. Higher Education

Our botanic garden represents a living lab for students. In the very beginning, students of the Faculty of medicine, followed by Pharmacy and Biology, made use of the Garden's living collections. Nowadays, our facilities are used by students from many more disciplines, such as science communication, landscape architecture, horticulture, museology, archaeology or sociology. Our university and our Faculty of Science would like to give the students the best learning environment possible. This translates to state-of-the-art laboratories and their contents, and we would like to provide students with the same level of quality in our Garden. A good example is our Systematic garden, where the evolution of and relationships between plants are shown using living specimens. Traditionally, evolutionary relationships could be revealed through characters observed with the naked eye or a microscope, but molecular systematics were developed around 1990, using the information from DNA material to establish a new system. This system, published by many taxonomists who formed the Angiosperm Phylogeny Group (2003), was used to create the Systematic Garden in Leiden in 2005.¹² In the meantime, scientists have investigated many more taxa and genes, and published the fourth update last year. Due to some major changes, we decided to rearrange our garden accordingly.¹³ This is a significant challenge, as practically all beds have to be emptied and replanted, not to mention the need to once again write up the necessary information for our scientists, students and visitors. However, the benefits derived from the internationally unified approach of harmonising physical collections, expanding online resources and publications, and enhancing standardisation of teaching far outweigh the requisite investment, in my view.

3. Public outreach

Administrators and decision-makers, politicians and the general public worldwide have recently been questioning the *raison d'être* of universities and especially scientists, let alone fundamental research activities.

As researchers, we cannot remain in our ivory tower. An academic botanic garden is, especially, a highly suitable forum for encouraging debates on important worldwide issues and challenges in the areas of food security and food safety, energy availability, water scarcity, climate change, habitat degradation and loss of biodiversity. This is due to the sheer number of people visiting our gardens, which rises to more than 1,000,000 per year in the Netherlands alone. Last year, the Hortus botanicus Leiden could welcome almost 150,000 guests of various target groups, from national to international tourists, families with children, schoolchildren, students and, especially, highly educated women and the elderly.

Our garden is therefore proud to be involved with 18 other partner organisations in an EU Horizon 2020 project called 'Big Picnic: Big Questions – Engaging the public with Responsible Research and Innovation on Food security'. In the next few years, we will bring together the public, scientists, policymakers and industry to tackle the global challenge of food security. Botanic gardens in 10 European countries and Uganda will co-create a range of exhibitions and participatory events with people from all walks of life, to generate dialogue and build a greater understanding of food security.

We will dedicate our activities in 2018 to the subject of food, we are co-creatively developing Science cafés on various food topics and we plan to jointly organise an exhibition, including workshops or seminars, on the topic. We already know that other Dutch botanical gardens, which are not part of the consortium, will also adopt this approach, and are therefore

sure that this will have quite an impact in the Netherlands. This subject is, of course, also very attractive to society as a whole, since everybody – even you – has to eat every day... don't you agree?

Living plants, either growing wild in the diverse tropical forests of Southeast Asia or cultivated and pampered in botanical gardens around the world, offer a rich diversity which we can enjoy, learn from or study. I am sure that the LUF Chair – Botanical Gardens and Botany of Southeast Asia will contribute to every field.

Acknowledgements

I am grateful to the Leiden University Faculty of Science, the Leiden University Funds (LUF) Board and the Curatorium of this special Chair for my appointment as professor.

My passion for biology, especially animals, was instilled in me by my parents, which means that, from primary school onwards, I told everybody that I would like to become a zoo director. That, unfortunately, has not happened so far, but we have so many animals in the Hortus that the Ministry wanted us to obtain official authorisation so we could keep mites, ladybirds and other beasts for biological control of our plant collections.

My school vacation work at Ploeger's Alpine plant nursery in De Bilt prompted my interest in the diversity, taxonomy and systematics of higher plants. Without Theo Ploeger, Senior, who explained many, many details of plants to me during weeks of weeding, I would not be able to appreciate the combination of intrinsic beauty in plants, especially flowers and fruits, and scientific questions.

The late – and quite eccentric – professor Huber in Kaiserslautern, who first supervised my master's thesis and then was my PhD promotor, motivated me to work with plants from Asia and promised me a field trip to Sri Lanka, which actually never materialised. He also predicted that I would have a glorious career in plant science if I could secure a position at the Rijksherbarium Leiden.

In 1988, the late professor Kalkman opened up the world of an internationally oriented herbarium, the library and Flora Malesiana to me, and of course the gateway to Indonesia and other countries of Southeast Asia. Even after his retirement, he coached me intensively in various difficult situations. Max van Balgooy was a sincere peer for teaching me about plants in

the field. He was frequently upset because I did not recognise plants he had explained to me a few minutes earlier.

Special thanks is due to all my counterparts and students in the field, especially the late Kade Sidiyasa and the staff of Herbarium Wanariset, Herbarium Bogoriense, Kebun Raya Bogor and many other institutes, who made my work in Asia successful and, at the same time, enjoyable.

Over the past ten years at the Hortus botanicus Leiden, I have been able to experience plants from yet another aspect – namely, using them as a storytelling artefact for scientists, students and visitors. Many colleagues, staff members and students have been of immense help to me in developing our research and education vision, mission and strategy, which resulted also in the establishment of this special Chair.

I would have loved to see my parents, my parents-in-law and my stepfather and stepmother Ploeger attend this occasion today. Every one of them supported me and my family in many difficult situations, over many years, and did not curtail our family activities abroad.

Last but not least, I would like to thank my wife Eva-Maria, our daughter Elisabeth and our son Vincent, all of whom have supported me unconditionally, especially during my long months of absence, and the evenings or weekends I spent working. Without Eva's love and organisational talent, I would not be here.

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PROF.DR. PAUL J.A. KEßLER



Photo Hielco Kuipers

1977-1982	Studied Biology, University of Kaiserslautern
1982-1986	PhD research, University of Kaiserslautern/ University of Hamburg
1982-1986	Volkswagen Stiftung researcher, University of Hamburg
1987-1988	Director, Botanic Garden - University of Bielefeld
1988-1989	Postdoctoral position (Deutsche Forschungsgemeinschaft) at Rijksherbarium Leiden, Leiden University
1989-2012	Researcher - Nationaal Herbarium Leiden, Leiden University
2006 to present	Prefect, Hortus botanicus Leiden - Leiden University
February 1, 2017	LUF Chair - Botanical Gardens and Botany of Southeast Asia

Paul Keßler was trained as a plant taxonomist at the University of Kaiserslautern and the University of Hamburg. For his master's and PhD theses, he studied the systematics of the genus *Orophea* in Southeast Asia and became interested

in the biodiversity of especially primitive plant families such as *Annonaceae* and *Menispermaceae*. As director of the University of Bielefeld Botanic Garden, he realised that botanical research on Southeast Asian taxa would be difficult to carry out in Germany. A postdoctoral grant from the German Research Society (DFG) made his work at the Rijksherbarium Leiden possible, as well as his first specimen-gathering trip to Indonesia, where his interest in Asian rainforest plants intensified. Various other research funds (Tropenbos International, GTZ, EU, ODA, Asian Development Bank, World Bank) enabled a number of extended field trips to almost all Southeast Asian countries, resulting in the establishment of various local herbaria, the collection of thousands of herbarium specimens, especially of tree families, and the signature of many research cooperation contracts with universities, botanic gardens or research institutes. He supervises researchers at the PhD and postdoctoral levels, as well as many MSc and BSc students, both nationally and internationally. In 2015, he was inducted into the Order of the Tulip by the World Tulip Summit Society, and received the 'Penning van de Universiteit Leiden (silver medal)' for special merits. He currently teaches Plant Systematics. Through his work for the EU Horizon 2020 project 'Big Picnic: Big Questions - Engaging the public with Responsible Research and Innovation on Food Security', he is bringing together the general public, scientists, policy-makers and industry to help address the global challenges of food security and safety. He is working with Universitas Indonesia to develop a twin garden for research and higher education.



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