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Flowerbeds and Hothouses: Botany, Gardens, and the Circulation of Knowledge in Things

*Esther Helena Arens**

Abstract: »Beet und Treibhaus. Botanik, Gärten und die Zirkulation von Dingwissen«. The development and management of planted spaces in Northwestern Europe in the 17th and 18th centuries depended on the possibilities for circulation in the republic of letters of the Dutch golden age. Circulation was accompanied by questions of managing space, information and "epistemic things" (Rheinberger) for botanists. Against the conceptual backdrop of "circulation" (Raj), "circulatory regimes" (Saunier) and "ensembles of things" (Hahn), this paper analyses, first, flowerbeds as a script for managing information that shaped botanical gardens across Europe in Leiden, Uppsala, Coimbra, and as far as Batavia according to Linnaean principles. Second, it investigates hothouses as spaces for managing things, and with it the role of knowledge in things handled by professional and amateur gardeners, not least the stove for pineapple cultivation. The paper concludes with reflections on the community of the material and the social around epistemic things, and the differing influences of description and narration in garden spaces.

Keywords: Botanical spaces, circulatory regime, epistemic things, flowerbed, gardener, hothouse, pineapple.

1. Introduction: Managing Plant Space in the 17th and 18th Centuries

Early greenhouses and hothouses were built around 1685 in the botanical gardens of Amsterdam, Leiden and the Chelsea Physic Garden close to London, as well as on manors in the Netherlands, mostly in the form of orangeries with hothouses at the sides and a protected front court (Den Hartog and Teune 2002, 199). These spaces housed foreign plants, which did not cease to circulate once they had reached such a European location. At the Dutch ports, they might pass through the hands of physicians and apothecaries (Egmond 2010, 213), while the "academic community was eager to speculate on what might lie in store" (Van Dijk 2002, 23). Rare plants from the Cape biotope found their way from the so-called mother gardens in Holland to places all over Europe (Kraus 1894,

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35). Additionally, there were those private collectors with professionally organised botanical spaces. For example Gaspar Fagel, a close adviser to *stadhouder* William of Orange, later William III of England, had established a fine garden at his estate Leeuwenhorst in Southern Holland. After Fagel's death, part of his plant collection was transferred to a new "glass garden" at Hampton Court in 1689, accompanied by Dutch gardeners, who not only helped to expand and document the collection of exotic plants. They also attended to the greenhouses and hothouses that were probably built by Dutch craftsmen (Den Hartog and Teune 2002, 201).

Managing space was one of the problems that gardeners and botanists had to deal with. In the so-called age of William and Mary (1688-1702), the second problem was managing information because of the sheer quantity of plants. In the Leiden botanical garden alone, the number of plant species had increased from 1,827 in 1668 to 3,029 in 1686 (Veldman 2012, 153). Pascal Schillings and Alexander van Wickeren have highlighted the role of different spatial frameworks in their introduction to the HSR Focus. Methodologically, localisation always runs counter to notions of the universality of science. On the concrete level of handling things, knowledge that has been inscribed into an object in one place might get lost on the way to another (Schillings and van Wickeren 2015, in this HSR Focus). On the one hand, botanists around the globe had corresponded patiently and extensively to determine certain plants, for example the merchant and natural historian G. E. Rumphius, stationed on Ambon in the Moluccas, with colleagues in Asia and Europe on the precise nature of sandalwood (e.g. Valentini 1714, 10). On the other hand, botanical communication was localised in Europe, for example when professors as Herman Boerhaave in Leiden used the early summer season to give public as well as private lectures in the hortus attached to the university (Heniger 1971, 6). A third problem was managing things by turning them into "objects that serve human purposes" (Lamb 2011, xi). After meeting with Boerhaave and other botanists in 1711, the English apothecary and botanist James Petiver "published a catalogue of the rare plants (in the Leiden hortus), a vital tool in the exchange of seeds, plants and occasionally trees between Leiden and London that ensued" (Hunting 2002, 9).

By the end of the 18th century, widespread commercial interests in and biological fascination with foreign, exotic and tropical plants had transformed into specific techniques of observation, data collection and taxonomy. While these techniques contributed and constituted to the so-called "European scientific hegemony" – managing the spaces and the channels of the circulation of knowledge in things –, they also perpetuated the "information overload," because "[n]ew entities like the genus entered the scene and created a foothold for the observation of a vast range of new relationships" (Charmantier and Müller-Wille 2012, 14). At the intersection of colonial history and the history of science, Londa Schiebinger has coined the term "linguistic imperialism" to point out the exclusion of non-European botanical knowledge and the substitution of multiple

perspectives with one metropolitan standard (Schiebinger 2004, 194ff). Within the botanical gardens of the 18th century, this ambivalence between the desire for diversity and the need for standardization can be observed as well.

The outlook of this colonial history of knowledge in botany has been global, concentrated on the flow of colonial plants and botanical discourse towards Europe, with gardening practices only recently coming into focus. This paper focuses on flowerbeds and hothouses as two particular spaces within academic and private gardens to discuss their function as site of exchange and appropriation in the North and towards the South. The idea of circulation is central both as an observation of movement and an analytical tool. Alette Fleischer has characterised the early modern Netherlands as an “entrepôt for matters, facts, and people” (Fleischer 2010, 144) and the garden “as an immovable site, formed an intersection of people, plants, and objects that continuously moved in, became transplanted or transformed, and then moved out again” (Fleischer 2010, 146). While immovable in Latour’s sense, the garden space is not immutable: “Gardening is a way of conducting natural inquiry and invention in order to control and govern landscapes” (Fleischer 2010, 1). What applies to the production of space by maps and the role of maps as “topographic repositories” in the 18th century, applies to the production of gardens by taxonomy as well. Antonio Lafuente and Nuria Valverde have underlined the function of maps as visualization of a future development as well as the inherent “effort to replace the rhetoric of description by that of formalization” in map-making (Lafuente and Valverde 2009, 198f). This corresponds with the standardization of garden layouts and plans.

Within these circumscribed garden spaces, then, early modern contemporaries themselves commented on circulations. For example, in the dedication to his *Hortus Cliffortianus* of 1737, Linnaeus had written: “The Botanist requires commercial Intercourse throughout the whole world, Libraries of practically all books published about plants, Gardens, Greenhouses, Hothouses, Gardeners” (English translation Heller 1968, 670). Obviously, persons circulated: Linnaeus from Sweden to Leiden and back, and shortly afterwards his patron Clifford’s gardener moved from Holland to Uppsala. Also information circulated: From the herbaria in Leiden, from Rumphius’ manuscript of *The Ambonese Herbal* (*Het Amboinsche Kruid-boek*) at Jan Burman’s place in Amsterdam. Finally, plants circulated by person or by mail, as the above-mentioned catalogue by Petiver illustrates.

For the history of the colonial sciences, Kapil Raj has defined circulation as “a ‘site’ of knowledge formation” that “brings to the fore” “the *mutable* nature of the knowledge makers themselves, as much as of the knowledges and skills that they embodied, their transformations and reconfigurations in the course of their geographical and social displacements” (Raj 2013, 346). Regarding circulation as a historical force, Pierre-Yves Saunier has also pointed out the factors of mutability, as “[c]irculations are created, avoided, desired, constrained, controlled, resisted and oriented.” Additionally, he establishes a meta-layer of “circu-

latory regimes,” defined as “the relatively stable patterns that characterize circulation in terms of context, direction, extent” (Saunier 2013, 59). In this paper, these two concepts of circulation are geared into each other: Within the context of early modern botanical gardens, the dynamics of colonial knowledge orders as circulatory regimes could determine the direction and the extent of the circulation of knowledge in things.

Therefore, the problem of overcoming distance that shaped botanical research is central for the analysis. Analysing Linnaeus’ discourse, John L. Heller has come to the conclusion that Linnaeus “seems to have regarded books as analogous to species of plants” (Heller 1968, 695) – both of them manageable objects, but also potentially things that are latent and excessive (Brown 2004, 5). Besides managing linguistic categories such as species or genus, the budding sciences attempted to manage their material setup around such things as seeds or rhizomes. According to Hans-Jörg Rheinberger, these are “epistemic things” an analytical tool for the scientist that he has defined as the “material entities or processes – physical structures, chemical reactions, biological functions – that constitute the objects of enquiry” (Rheinberger 1997, 28). As structures and functions that are alive, dried and able to come alive or dried and dead, the entities as well as processes of early modern plants proved difficult to handle and stabilise. Also, the process of handling plants calls for a certain type of knowledge practice, namely implicit or “embodied knowledge” (cf. Sennett 2008, 57).

As foreign – “exotic” and tropical – plants cannot be analysed individually, this paper connects the material and the scientific with the social, and focuses on the flowerbed and the hothouse as two different examples of “ensembles of things.” These ensembles were in turn part of botanical circulations between garden spaces because “the totality of objects [in an arrangement] communicates specific meaning, not the isolated object” (Hahn 2005, 142, my translation). This paper also draws on findings from cultural analyses of things for consumption in the 18th century (cf. Baird 2013, 15) and applies the following questions to the flowerbed and the hothouse: Did these ensembles of plant and garden things move across borders, for example between the private and the public, the academic and the popular, the national and the imperial spaces? If so, did they reorganize spaces, if not, how were their meanings and values adapted? Examples are drawn from gardens in the Netherlands as places where botanical knowledge was produced, from Holland as one important node in botanical networks, from gardens in England and Scotland as places of botanical consumption, and from gardens in India, Indonesia and the Carribean as places of appropriation. Sources are contemporary illustrations as well as letters that had been widely circulated during the 18th century already, and which for the most part have been digitalized by different institutions today. Because the argument is not about invention, but about movement, this paper takes a look at the 18th century on the whole.

2. Managing Information: Flowerbeds as Circulating Script?

The exchange of information via flowerbeds can be categorised as a circulatory regime managed by trade companies and other state agencies, both of which funded researchers, regulated the transport of objects, and controlled narratives about meaning and value in the South as well as to the North. Still, the implied movement of individual plants almost defies analytical categorisation.

In the second part of the 18th century, especially with the 1758 edition of Linnaeus's *Systemae Naturae*, the problem of classification, taxonomy, nomenclature and identification seemed to be solved. With its binominal structure of genus and species, the system enabled naturalists to precisely describe plants to their colleagues and thus accelerated not only correspondence, but the transformation of information into the European scientific body of knowledge. Like other scientists, botanists now focused on "appearance and regularities rather than on individual cases, anomalies and symbolic meanings" (Jorink 1999, 90f). Isabelle Charmantier has concluded that Linnaeus used "strict organizational patterns" for his texts, images and diagrams in researching as well as publishing, and that this writing practice was connected to the practice of botany in the garden (Charmantier 2011, 403f). From plants to sketches to books to plants again: Linnaeus's standards were implemented via the flowerbed in botanical gardens in European-dominated territories around the world. Ann-Mari Jönsson has pointed out that the sexual system as theory translated into a practical method in the garden that could be applied by professionals and amateurs alike to "get results straightaway" (Jönsson 2011, 80).

Not every colleague took to Linnaeus' system immediately, though (cf. in Göttingen Albrecht von Haller, discussed in Goerke 1954). When Linnaeus came to the Chelsea Physic Garden in 1736/37 with an introduction by Boerhaave, its gardener Philip Miller "reacted to Linnaeus's suggestion that there was a simple method of naming plants with a scowl" and director and lecturer (*praefectus horti*) Isaac Rand "was unreceptive to the binomial nomenclature" (Hunting 2002, 10). But by 1790, Richard Pulteney reported that Linnaeus' method "excited that curiosity, which novelty will ever attract" (Pulteney 1790, 346). He went on to evaluate it positively:

The simplicity of the classical characters as the basis, the uniformity of the generical notes, confined wholly to the parts of fructification, and that precision which marked the specific distinctions, advantages, of which all foregoing systems were destitute, soon commanded the assent of the unprejudiced; and an interval of a few years, gave Linnaeus's method a decided superiority with *English* botanists (Pulteney 1790, 347).

For example, Patrick Browne used it to arrange the plants in *The civil and natural history of Jamaica* 1756, and J. Hill in *Flora Britannica* of 1760 (Pulteney 1790,

349, 351), both of which could be understood as printed formalization of flowerbeds. Finally, in 1776, the “gentleman physician” William Withering popularized Linnaean principles with his *Botanical Arrangement*, which included “a guide to the pronunciation of Latin names from the second edition” (Secord 1994, 298).

Leiden, on the other hand, was a place of early adoption. In 1737, professor of botany and garden director Adriaan van Royen had accepted Linnaeus’s support when redesigning the academic *hortus*. In his subsequent catalogue *Florae Leydensis Prodromus*, which was published in 1740, van Royen closely followed the newly established procedures and patterns and mapped the garden territory accordingly. The catalogue included a detailed plan (*prospectus*) with numbers for the flowerbeds representing the *classicus plantarum* and with letters referring to the different types of greenhouses and hothouses (Royen 1740 between XX and I; cf. Uffelen 2012, 147). In neighbouring Utrecht in 1747, professor of medicine, botany and chemistry Evert Jacob Wachendorff published a catalogue of his botanical garden, *Horti Ultrajectini index*, “in which plants were described according to the Linnaean tradition and the same names of genera were used as in Linnaeus’s second edition of *Genera plantarum* (1742)” (Jönsson 2011, 180). In Batavia in 1757, physician and botanist Christiaan Kleynhoff took over the already established *hortus medicus naturalis* on the Crocot river, also dubbed “Eden,” the first official garden for research purposes in Asia (Florijn 1985, 214).

The grouping of flowers followed Linnaeus’s sexual system conscientiously. The collection developed rapidly, till it contained more than a thousand species, but in 1762, one year after [Jacob] Mossel’s [governor-general of the Dutch East India Company] death, his successor P.A. van der Parra [...] sold the garden to a private individual, this being one of the reasons why Kleynhoff repatriated (Florijn 1987, 35).

When again resident in Culemborg in the Netherlands, Kleynhoff sent a catalogue and a sketch of a map (*ruwe schets*) to Linnaeus on 12 March 1766 (Florijn 1985, 214). Kleynhoff’s resignation is interesting in the context of the privatization of a previously semi-public garden as it may point to a newish conflict between commerce and science: in a regime of private commercial circulation, epistemic things turn into objects to be sold and/or consumed instead of being investigated. It took a couple of decades and the dissolution of the Dutch East India Company before the new colonial regime in Batavia decided to establish *s’ Lands Plantentuin te Buitenzorg* as botanical and agricultural research centre in 1817.

In Coimbra, Portugal in 1772, the university reformed its structure and established a chair for natural history with Domenico Vandelli, one of the naturalists Linnaeus corresponded with. Vandelli also organised a new botanical garden according to Linnaeus’s principles of classification (Fontes da Costa 2011, 228). These taxonomical groupings, today still named “order beds” or “Escolas sistematicas,” excepted only those tropical and subtropical plants that

required different temperature and humidity. A glance at a contemporary early modern map (Elsden ca. 1773) shows that the localisation of the circulated script appeared as systematic as the plans of Leiden and Uppsala (Linné 1745). On the surface, there might have been an ornament left here and there on those plans, perhaps in step with the conventions of the copper plate producers, but the formal structure as well as the content of the flowerbeds was scripted according to Linnaeus' binary logic. A script that shaped the territory, thus illustrating Schiebinger's conclusion: "With the rise of the modern botany, a uniquely European system of nomenclature developed that swallowed into itself the diverse geographic and cultural identities of the world's flora" (Schiebinger 2004, 227). From the wealth of plants at his disposal during his time in Holland and through his network afterwards, Linnaeus and his collaborators had moved from individual (historical) plants to a general theory which in turn imposed the same logic on different circumstances.

Different strands of botanical scripts and circulatory regimes, the commercial and the academic, came together in Bengal with the development of the Calcutta Botanic Garden, which had first been overseen professionally by the botanist Johan Koenig, "a student of Linnaeus who worked in Southern India." On June 1, 1786, army officer Robert Kyd wrote a letter arguing to fund the garden more comfortably "for establishing a stock for disseminating such articles as may prove beneficial to the inhabitants, as well of the natives of Great Britain," including what was termed famine crops (Thomas 2006, 166f). Kyd's initiative overlapped with a request from London in September 1786 "to supply plants for His Majesty's Botanic Garden in St. Vincent." In 1793, William Roxburgh, surgeon of the East India Company and qualified as manager of another botanical garden in the Madras presidency, took over as superintendent. Within a short time he was successfully circulating crops around the British empire: "By the end of 1793 he was distributing teak seed, Bengal hemp, Virginia tobacco, Carulean Indigo and Arabian Coffee, and sending plants to England, St Helena, the West Indies and different parts of India" (Thomas 2006, 171f). Roxburgh also acted as "Supervisor on scientific activities – for example [...] the production of 2,533 coloured drawings," so that "gradually a scientific element came in." It took the British East India Company a couple of years to "formally acknowledg[e] for the first time in January 1807 that the Garden had a scientific purpose" (Thomas 2006, 174f).

The number of botanical gardens in different regions of the world mattered because the availability of plants was directly connected to the quality of research. In his foreword to the already mentioned *Hortus Cliffortianus*, Linnaeus had emphasized the value of direct observation: "Thus in truth these names are not properties of the memory, like those of the ancients, but in the work of judgement and written on the plants themselves" (English translation Heller 1968, 676). In that sense, knowledge in things was reduced to seeing, reading and perhaps translating. Daston and Galison have pointed out that naturalists usually

surrounded their sketches with handwritten text. The sketches were explicitly integrated in the process of observation and reflection, as a means to think rather than illustrations for sale. According to contemporaries, their handwritten marginal notes transformed craft into reason (Daston and Galison 2007, 91). Anne Secord has pointed out that “[the] accessibility of the Linnaean classification made it a powerful tool for the production of reliable information by local collectors and travellers” (Secord 1994, 298). One example is Christopher Smith, who worked as botanist on the Moluccas during the first occupation by the British from 1796-1802. After collecting plants on Ambon, Banda and Ternate, he sent numerous living and dried specimen to William Roxburgh in Calcutta (Warburg 1902, 66). If looking at the bigger picture of an imperial history of knowledge, then, there is evidence for the “multiple centres of scientific exchange, scattered over the globe, and characterised by lively exchange” Monica Juneja has conceptualised (Juneja 2003, 96).

On the one hand, the movement of the plants themselves can be regarded as mere transfer from one geographical place to another. On the other hand, because of the ambivalent status as living organisms, an individually re-localised plant might change from defined and classified botanical object for scientific consumption back into an unmanageable thing depending on soil, tools, weather, etc. – the instability of the scientific epistemic thing. When scrutinizing the plant organism as part of an ensemble of things beyond the boundaries of a laboratory, though, mutability comes into play: An accompanying letter might be lost, or the container damaged – both opening a chance for experimentation and speculation. And a description of appearance and use might be translated and adapted to fit into another bio-social space. In comparison, the globalized ensemble of the post-Linnaean flowerbed seems strangely fixed and not part of circulation as transformation. Rather, it seems to fit into Latour’s definition of a network, with its differentiation of passive links – here, the participating academics only passing on standardised information – and active intermediates – in this case, craftsmen with their embodied knowledge that enabled them to modify and transform botanical objects. If the epistemic thing required only short-term handling, this embodied knowledge was reduced to mere service delivery (cf. Latour 2010, 70). For example, the botanical garden in Calcutta “employed highly skilled Indian artists but there was little attempt to exchange botanical knowledge with the Indian population” (Thomas 2006, 177). It was not by accident, either, that the gardener, who must have advised Linnaeus, was not mentioned at all in his books. In Herman Boerhaave’s *Index plantarum quae in horto academic Lugduno-Batavo reperiuntur* from 1710, a woodcut depicts the professor wigged and hatted and generally elegantly clothed, an aristocrat of botany centre stage in conversation with two other gentlemen. He points to the right hand side, where a gardener in ordinary working clothes kneels in front of a big potted plant, actually getting his hands dirty while the feet of statues in the backdrop are elevated above his plane. The gardener seems to be reduced to

the status of attendee to the plant, both of them movable and transferable in response to academic needs (Boerhaave 1710, Frontispiece; cf. Hofstijzer 2012, 117). Against this backdrop, the Linnaean flowerbed can be understood as standardisation. It was a tool to reduce ambivalence and complexity, to prevent transformation and to reach a state of stability within an exclusive group – a counter-reaction as proof for circulation.

Figure 1: Frontispiece of Herman Boerhaave's *Index*, 1710



Reference: Herman Boerhaave. 1710. *Index plantarum quae in horto academic Lugduno-Batavo reperiuntur*. Lugduni Batavorum: Cornelius Boutestein. University Library Cologne, N 10/45.

In Europe, gardeners did react to this change that might be described as a switch from one circulatory regime to another within the space of the *hortus*. Jacob Ligtvoet, for example, chief gardener (*hortulanus*) in Leiden from 1723 to 1752, began to acquire specimens to establish his own collections of plants and animals, and he also built a library of his own (which was auctioned after his death). Even though he did not have the training to draw information from academic books written in Latin and therefore could not participate in scientific debates over classification, he was able to transfer his knowledge into readable and replicable forms of media. He wrote a *herbarius vivus* which was appreciated as exemplary notebook and reference. His successor Nicolaas Meerburg followed in these footsteps and published a book on “Illustrations of strange plants (Af-

beeldingen van zeldzame gewassen)” in 1775 (Hoftijzer 2012, 119f) In 1730, the already mentioned Philip Miller of the Chelsea Physic Garden, whose “Gardener’s and Florist’s Dictionary” saw eight editions after its first publication, ran into conflict with Isaac Rand when compiling a catalogue. Rand accused him of putting together a “library” instead of a “teaching aid” or “running catalogue” (Hunting 2002, 14f). As Ligtvoet in Leiden, Miller in London also had assembled a “valuable library” that was auctioned on 12 April 1774 (Baker and Leigh 1774).

With the realisation of the Linnaean script in flowerbeds all over the world, the craftsmen-gardeners, who had long been part of global circulation in Raj’s sense as site of knowledge formation, were one of the actor groups now excluded from formalized academic discourse in Latin (cf. Hoftijzer 2012, 114, 117), busy with plants as epistemic things in laboratory situation. There was an opening for the gardeners, however, if they switched to a regime of commercial circulation, enabling them to profit from their craftsmanship and to contribute to knowledge formation via a popularized discourse in the vernacular on the ensembles of garden things.

3. Managing Things: Circulation in Hothouses

The figure of the gardener and the hands-on aspect of managing botanical information within hothouses leads to an interesting question concerning the different modes of managing: If language and text are central to academic knowledge, how are tools related to embodied knowledge, and how can this knowledge be exchanged and appropriated? (cf. Breidbach 2008) Ensembles of botanical things could include specialised and expensive instruments. For example when a banana flowered under Linnaeus’s care in Clifford’s garden at Hartekamp estate south of Haarlem:

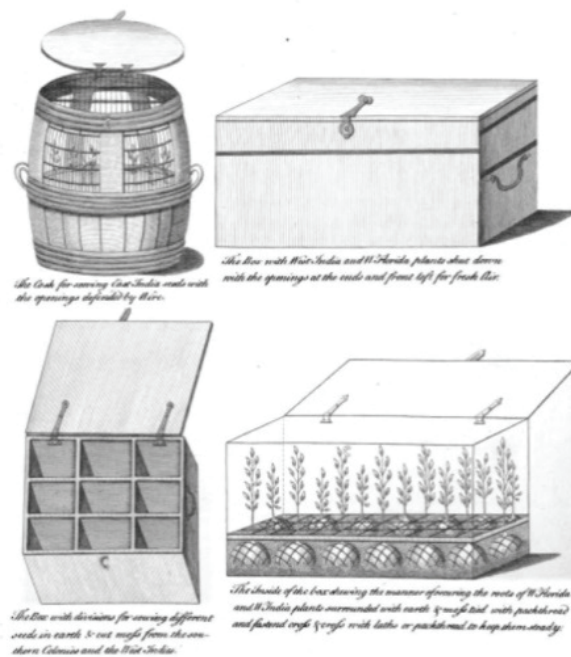
At various points he [Linnaeus] mentions certain ‘degrees of heat’ as maxima beyond which the greenhouse should not be warmed. These must refer to the centigrade thermometer with which Linnaeus had been experimenting and which is depicted in the lower hand corner of the engraved frontispiece of the Hortus Cliffortianus (Heller 1968, 667).

The challenges of circulation and acclimatization (cf. Koerner 2001) were managed differently on the imperial and on the European scale.

Within the British and the French empires, colonised islands in the tropics functioned as hothouses, and their botanical governance was closely intertwined with political ecology. For example, leading British botanist and patron Joseph Banks favoured “a worldwide network of botanic gardens which would make possible large-scale transfer of crops” (Thomas 2006, 176). Within such a circulatory regime between different imperial spaces (cf. Drayton 2000), it was crucial to manage information in a metaphorical sense – the information coded within the plants themselves genetically – and therefore to manage the ensemble of

things needed to transport plants via shipping networks. In 1770, John Ellis, “Fellow of the Royal Society and Agent for Dominica,” published his “Directions for Bringing Over Seeds and Plants from the East-Indies and Other Distant Countries in a State of Vegetation” (Howard 1954, 382). The frontispiece depicted a cask and several boxes for an immediate understanding of the management of light and air. The book was published in London with an appendix about “the figure and botanical description of a new sensitive plant,” which points to a crossover of practical and scientific knowledge on the site of a commercially successful print culture.

Figure 2: Frontispiece of John Ellis *Directions*, 1770



Reference: John Ellis. 1770. *Directions for Bringing Over Seeds and Plants from the East-Indies and Other Distant Countries in a State of Vegetation*. London: L. Davis. University Library Cologne, V 42/254.

The practical advice must have been in demand. On the Caribbean island of St. Vincent, around 1770, the governor in chief of the Windward Federation of Islands suggested to George Young, “principal medical officer” and “an ardent horticulturalist,” to establish a botanical garden “modelled after Kew Gardens” for “cultivation and improvement” and “importation.” By 1773, the Royal Society recognized this garden “for having 140 healthy cinnamon, mango, and nutmeg trees, and so on,” species that had been imported from Asia (Howard

1954, 382). The practice of managing ensembles of things in the garden and the attached values of science and governance played out even in conflict between empires. During the French occupation of St. Vincent from 1780-83, General de Bouillé, a friend of Joseph Banks among others, oversaw the “continuation of [the garden’s] work, even aiding the curator in obtaining plants from the French colonies overseas.” The French had established a *jardin botanique* in Pamplemousses on Mauritius – a metropolitan site for botany applied as agriculture and horticulture (cf. Rouillard 1983) – and were successful with “the transfer of nutmeg and spice cultivation to their West Indian possessions” (Thomas 2006, 170). When the British captured a French ship with living plants in its cargo, they sent specimen, including jackfruit, to St. Vincent. After the war, Young’s successor Alex Anderson received cloves from Martinique in 1787 and breadfruit in 1793 (Howard 1954, 384f). By 1800, a catalogue of the garden listed diverse “commercial and medicinal plants; esculents; medicinal; in economy; fruits; valuable woods; exotics, curious and ornamental plants” (Howard 1954, 386).

The epistemic things in question had been stabilized into commercial objects via the island hothouse as laboratory. While there was a moment of diversity when exogenous plants were introduced to one of these sites, in the long run the concentration on useful plants led to the same cash crops managed in plantation economies and to a formalized situation akin to the flowerbed – from a Eurocentric point of view, that is, disregarding appropriation by workers on the spot.

The situation was different in the North: To raise and study tropical plants in Europe, transport skills were not sufficient. Gardeners had to know how to manage the ensembles of plants and instruments within hothouses. So-called *hibernacula* with heating devices had been used already in mid-17th-century Leiden. By the middle of the 18th century, gardeners distinguished simple glass from winter houses (Kraus 1894, 61). For example, the Physic Garden in Chelsea introduced a heated greenhouse in 1732 (Hunting 2002, 16). The Dutch art historian M. M. Sikkens-De Zwaan has concluded that such a technical innovation must have come from actors in the field of science and not from the group of collectors (Sikkens-De Zwaan 2002, 212). On the other hand, Florike Egmond cautions that “private gardens – as distinct from university botanical ones – have as yet only been rarely studied as locations of knowledge since they are generally categorized under pleasure and leisure” (Egmond 2010, 212f). In the British context, Penelope Hunting makes clear that science was only one part of managing garden things successfully, pointing out the “equally productive exchange between landowners, botanists and gardeners” (Hunting 2002, 10).

In the Leiden botanical garden, knowledge about seeds and plant nurseries had been embodied in the *hortulanus*, the professional gardener with many years of practice (Hoftijzer 2012, 120). And on similar sites elsewhere in Europe, academic and private botanists competed for this tacit knowledge as a crucial resource to keep plants alive and productive. In a letter by the Anglo-Dutch merchant, collector and patron George Clifford to Carl Linnaeus from 20

April 1739, Clifford mentions books he sent to Linnaeus before and “seeds for annuals (*annale saaden*)” he enclosed in this letter. Also he “complains about the damage done to his plants by the incessant rain, but even more about the fact that his gardener has unexpectedly resigned because Linnaeus has asked him to come to Sweden. Clifford feels he does not deserve such treatment.”¹

From the 1730s onwards, Philip Miller, gardener of the Chelsea Physic Garden, had popularized practical knowledge by way of *The Gardeners Dictionary* which was first published in 1731. The book was translated into other European languages, for example into German in the 1750s (cf. Huth 1750, Title page). In the entries for “Green-House” and “Stove,” Miller describes the technical problems of managing a hothouse:

There are some people who commonly make use of pots filled with charcoal to set in their Green-house in very severe frosts, but this is very dangerous to the persons who attend these fires, and I have sometimes known they have been almost suffocated therewith, and at the same time, they are very injurious to the plants (Miller 1768).

When he illustrates the proper construction of stoves, he also mentions the various tools and processes required for regulating the temperature, from the thermometer to movable covers:

Over the top sliding-glasses there should be either wooden shutters, or tarpaulins fixed in frames to cover them in bad weather, to prevent the wet from getting through the glasses, and to secure them from being broken by storms of hail, and these outer coverings will be very serviceable to keep out the frost (Miller 1768).

The Dictionary has two rather similar plans for “the Large Tan Stove” and the “Tan Stove for the Younge Ananas Plants” that not only show how many panes of glass would be used, but also mention the need of an “Iron Bar for supporting the Roof” (Miller 1768). Finally, Miller suggests a specific arrangement for managing plants:

Thus by contriving the green-house in the middle, and one Stove and a glass-case at each end, there will be a conveniency to keep plants from all the different parts of the world, which can be not otherwise maintained but by placing them in different degrees of heat, according to the places of their native growth (Miller 1768).

By the end of the 18th century, tropical plants such as banana, cacao, ginger, papaya, or tamarind were by and large standard fare within the hothouses (Kraus 1894, 62).

The success of Miller’s dictionary suggests that, in the course of the 18th century, wealthy amateurs who could muster the glass and window taxes could master gardening as well. The technology of green- and hothouses had spread out from the Netherlands to Scotland in the North, especially “driven by the

¹ Letter L0270 at <<http://linnaeus.c18.net>>, Dutch original and English summary.

enormous popularity of pineapple cultivation” (Law 2007, 183). James Justice had included a plan for a greenhouse in his *The Scots Gardiners Director*, published in Edinburgh in 1754, “with which the introduction of windows at either end suggests the progenitor of the lean-to greenhouses that would become widely used in the walled gardens of estates” (Mackay 174). Hothouses were available as well, as an earlier correspondence from 1730 proves

I have a pretty promising aspect in my Gardens of some new beautis, I have 8 of the Ananas in fine fruit, many of the Coffie berries of a fine Cherry colour upon the tree [...] The Guajavas are preparing for blossom: in short all my Exoticks are in a mighty prosperous thriving condition in the Stoves as well as the greenhouse (quoted in Mackay 2001, 173).

On the plan for a “Pine Apple Stove” from 1732, a large top view corresponds with a smaller cross section to show how this garden ensemble is all about circulation for the treasured epistemic thing: heat, air, and light (Justice 1754, between 118 and 119). The trial phase lasted a few decades, but “[b]y the 1780s stoves for producing hot moist atmospheres had been perfected” (Law 2007, 183).

Within the hothouse, the Latin script of classification faded in favour of the mundane word and thing ensembles of stove, flue and tan-bed, glass, shades and pots etc. Instead of an academic prodromus, the self-learned gardener in Britain picked up a commercial catalogue by one of those companies catering to his needs such as “Conrad Loddiges nursery and seedsman at Hakney near London” (mentioned in Kraus 1894, 55). According to imperial circumstances in Britain and France as well, the old world plants from the Cape, India and the East Indies were joined by plants from North America and the Caribbean West Indies. For example, the Society for the Importation of Foreign Seeds had specialised in North American species in 1765 (Mackay 2001, 188). Another catalogue from 1783, while listing its products alphabetically by their binary Latin names, gave advice to its buyers by marking those items with a star that “are desirable in every Collection for the beauty or fragrance of their Foliage, Flowers, Stateliness of Growth, Season of Flowering, or some other striking property agreeable to the Eye” (Gordon 1783, Title). Among those for the hothouse was the “Surinam Pine apple, with most beautiful, silver-strip’d leaves” (Gordon 1783, 119).

By way of hands, experimentation, and craftsmanship, the former epistemic thing, having reached the hothouse in Northwestern Europe, had shapeshifted first into an aesthetic and subsequently into a marketable object. A catalogue sold in 1800 by a company of Lewisham in Kent listed eight types of “Pine-Apples” and additionally advertised “Plans of Green Houses, Hot-Houses, &c. drawn, and the Buildings executed upon the most approved Principles of Neatness and Utility” (Russell 1800, Title, 14).

4. Conclusion: Knowledge in Things – The Material and the Social

The close ties between the “natural, social and discursive aspects of circulating objects” (Rheinberger 2007, 125, translation eha) in general, and between different botanical spaces in particular, goes beyond questions of material culture in the history of science via the practices towards “narratives of control, desire, or empathy” (Baird 2013, 14f). While plants in the academic sphere shaped the social space they inhabited, for example by initiating the director’s lectures with their flowering season, the traditional sources on botany do not give away much information on ways of circulating knowledge via private gardens.

In the course of the 18th century, ensembles of things and epistemic things had fallen apart and reconstituted according to shifts in circulatory regimes, for example, in the context of the private-public-private circulations emanating from Holland: The private hothouse of the merchant Clifford had turned into a laboratory for Linnaeus’ research, the botanical garden in Uppsala had provided a template for the garden project of the Dutch East India company in Batavia. And in the exchange of plants between the *hortus* in Leiden and the Chelsea Physic Garden in London lay the foundation for the development of botanical business in the late 18th century.

The circulation of knowledge in botanical things does not naturally flow into a universally positive reading of the development of science during the enlightenment. It differs from the textbook reading that “fields which had been separated before, namely tacit knowledge, mathematic-technical calculation and theoretical explication, were brought together for mutual profit” (Stollberg-Rilinger 2011, 191, my translation). Rather, in the developments highlighted here, the “disciplinisation” (Braidbach) as part of a “process of closing” (*Schließungsprozess*, Rheinberger) widened pre-existing gaps between the field and the laboratory, however close quarters they might have kept within the layout of one garden. The separation of “hand and head, technique and science” damages “both understanding and expression” (Sennett 2008, 20) theoretically, and restricted access to science practically, as Anne Secord has observed for the first part of the 19th century (Secord 1994, 297). In this respect, in the larger context of a global and postcolonial history of knowledge, an investigation of alternative botanical ensembles might be fruitful, for example of the development of the Native American “three sisters,” a technique of companion planting.

After the scientific mapping of the flowerbed, and the corresponding reductive formalization of seed banks and catalogues like the *Index Seminum et Sporiarum* from Coimbra, circulation ceased to be transformative as the epistemic thing was declared a defined object across the globe. More and more the list prevailed, not the crafty representation of plants. The aim was, surely, stability in those scientific territories spanning continents: “Knowledge is essentially deter-

mined by order” (Breidbach 2008, 25, my translation). Lists as an ordering principle not only informed the structure and content of the flowerbeds in the academic context, but also the composition of commercial garden catalogues.

Hothouses, however, still bore the seed of abundance (flowering season) as well as disorder (cross-pollination, fire) in them. Inducing a reshuffling of tools and plants, they could upset the corresponding orders back into subversive motion, for practical as well as for aesthetic reasons. A comparison of the ensembles hothouse, orangery and artistic gardens would be interesting in this respect as re-introduction of the “unfamiliar or indeterminate” (Pepperell 2011, 273).

The script of the flowerbed was informative only to the savant in its descriptiveness (cf. Klotz 2013, 209), and it was not about the good company of plants and humans. By contrast, when Liverpool’s wealthy merchants funded a public botanical garden in 1803, it was not designed to illustrate a scientific principle. Instead, the garden space circulated its visitors along paths of entertaining dimensions: A plan from 1808 referred them to Rock Plants, Bog Plants, and a Pond. Still, the ensembles of the Conservatory “divided into five climactic zones” (Law 2007, 180) invited exploration, but determined the narrative of universally acknowledged botanical spaces, and popularized those laws imperially “written on the plants themselves” according to Linnaeus.

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