*Journal of the History of Collections* vol. 30 no. 1 (2018) pp. 1–14

# Seventeenth-century plant lists and herbarium collections

## A case study from the Oxford Physic Garden

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*Lists of pre-Linnaean polynomial names of the plants growing in seventeenth-century European living plant collections are commonplace. However, comparison among lists and interpretation of polynomials in terms of modern Linnaean binomials is a major challenge for researchers. This paper shows the importance of extant pre-Linnaean collections of herbarium specimens for interpreting lists of plant names. More than 4,000 polynomials reported from the Oxford Physic Garden between 1648 and 1676 are linked to over 1,300 Linnaean species names based on an objective methodology. These fundamental data show that medicinal, culinary and ornamental plants attracted attention in the seventeenth-century garden but that most species were primarily of botanical interest. Nearly 60 per cent of the species were introductions to Britain. Linnaean binomials reveal how the number and sorts of species changed between 1648 and 1676 and how the garden was used.*



Collections of natural history objects, amassed by networks of individuals connected by shared interests, correspondence, field excursions and the sale and exchange of specimens have contributed directly to our understanding of the natural world.[1] In sixteenth-century Europe, the range of plants grown in private and institutional gardens expanded as new ideas about the natural world were investigated and continents were explored for plants with economic or social benefits, including medicine, food, wealth and personal influence. At about the same time, cultivation of medicinal plants in physic gardens was established in Italy and spread through continental Europe into Britain. With physic gardens came the development of long-term plant preservation techniques, leading to the creation of 'dried' or 'winter' gardens, today known as herbaria.[2] In seventeenth-century England, herbaria were unusual, expensive curiosities but they rapidly became essential tools for natural philosophers investigating the natural world.

In the 1660s, Edward Morgan (?1619–1689), gardener at the Westminster Physic Garden, created at least one herbarium, and Oxford-trained clergyman John Ward (1629–1681) had a 'Botanologicall Booke'.[3] On 5 November 1665, Samuel Pepys (1633–1703) described his surprise at the novelty of being shown John Evelyn's (1620–1706) herbarium: 'leaves laid up in a book of several plants kept dry, which preserve colour, however, and look very finely, better than any Herball.'[4] In Oxford, during the 1680s, John Locke (1632–1704) made a herbarium to complement his botanical studies.[5]

Naturally, collectors of living or dead plants wished others to know what they possessed. Consequently, lists of the plants in European physic gardens and private collections were published and circulated.[6] Some of these publications, such as Basil Besler's *Hortus Eystettensis* (1613), an account of the plants in the garden of Johann Konrad von Gemmingen, prince bishop of Eichstätt (Bavaria), were expensive luxuries.[7] Others, such as the detailed descriptive and illustrated catalogues of the private gardens of John Gerard (*c*.1545–1612) and John Parkinson (1567–1650), became standard reference texts for institutional and private plant collections for decades after their publication.[8] However, the limited market and expense of preparing and printing illustrations meant most catalogues lacked either descriptions or illustrations; they were lists of names, for example Simon Warton's *Schola Botanica* (1689), James Sutherland's *Hortus Medicus Edinburgensis* (1683) and Robert Morison's *Hortus Regius Blesensis* (1669).


doi:10.1093/jhc/fhx015 Advance Access publication 8 June 2017

Early modern physic gardens were envisioned as places where medicinal plants could be displayed together with their correct names. For example, in 1658, on publication of a catalogue to the Oxford Physic Garden, the physician who 'be puffed up with vain perswasion of his own abilities, and shall think because he hath the title of Doctor he may be as idle as he please, and slight the study of Simples'[9] was warned that the garden might teach him something. In the late seventeenth century, Thomas Baskerville (1630–1720) considered the Oxford Physic Garden 'of great use & ornament, prouving serviceable not only to all Physitians, Apothecaryes, and those who are more imediately concerned in the practise of Physick, but to persons of all qualities seruing to help y$^{e}$ diseased and for y$^{e}$ delight & pleasure of those of perfect health.'[10] Thomas Sydenham (1624–1689), was less sanguine. He had a poor opinion of universities generally, and Oxford in particular, as places to learn practical medicine: 'one had as good send a man to Oxford to learn shoemaking as practicing physick'.[11]

Names are flags conferring identity and enabling information about the natural world to be acquired, ordered, stored and transmitted in time and space. Names may also be used to assert possession or denote an individual's status. In the pre-Linnaean era, formal names for natural history objects were usually phrase names (polynomials). However, independent of whether a name is a polynomial, modern binomial or even vernacular name, for maximum use a name should be (1) applied unambiguously and (2) mean the same thing to all users. The correct application of names therefore has direct scientific, economic and social consequences.

Early modern and modern plant lists are likely to suffer from similar problems with specimen identification. Modern herbarium collections have expanded dramatically over the past three decades but are known to be replete with misidentifications; one headline estimate states on average 50 per cent of herbarium specimens are incorrectly named.[12] There is no reason to suppose identifications based on herbarium specimens are poorer than those based on living plants or that seventeenth-century naturalists were poorer at identification than their modern counterparts. Herbarium specimens therefore become essential for interpreting early modern plant lists, and making objective comparisons among such lists. Unfortunately, early modern plant lists complemented by herbarium specimens are very rare.

## Plant identification

Correctly naming a plant is a complex process dependent on the quality of the material being named and the comparative material available, together with an individual's experience of, and competence at, naming plants. Furthermore, groups of plants vary in the features that are important for their identification, although generally fruits and flowers may provide more important features than either leaves or other vegetative parts. Comparative materials for identification are wide-ranging, taking the form of descriptions, illustrations or preserved specimens. However, in the early modern period, the quality of, and access to, comparative identification material was limited. Furthermore, in the absence of a common descriptive botanical language and a type concept, natural historians needed a detailed understanding of the work of individual authors and were highly dependent on the quality of these authors' descriptions and illustrations, together with membership of networks of natural historians.

Biological features of plants may compound social aspects of the identification process. For example, seeds exchanged under one name, among individuals growing many closely-related species of the same genus in their gardens, may prove to be hybrids and therefore something new. For example, the London Plane (*Platanus* × *hispanica*), a garden hybrid, was described as 'Platanus inter Orientalem et Occidentalem media', an intermediate between the western (*P. occidentalis*) and eastern (*P. orientalis*) planes, by the keeper of the Oxford Physic Garden in the late seventeenth century.[13] The distinctiveness of a species from its close relatives and the subtlety of the characters used for identification present other challenges. For example, the rose (*Rosa*) and dandelion (*Taraxacum*) genera are distinct within the British flora and can be readily identified from even fragmentary botanical specimens or crude drawings. However, trying to separate *Rosa canina* (dog rose) or *Taraxacum officinale* (common dandelion) from their close relatives requires a specialist botanist and specimens carefully-collected at specific times of the year, or illustrations of exceptional quality.[14] Ultimately, plant identifications are

hypotheses refuted by examining specimens (vouchers) named by the person responsible for putting together a species list. Identifications based solely on lists of names, and lacking voucher specimens, rely on the authority of the list compiler.

This paper focuses on the plants in the seventeenth-century Oxford Physic Garden, Britain's oldest surviving scientific collection of living plants, to illustrate the utility of links between living and dried collections. Taking advantage of contemporary species lists and herbarium specimens made by the garden's first two keepers, three questions are addressed about the seventeenth-century garden: (1) What plants were grown? (2) Did the plants growing in the garden change over time? (3) How was the garden used?

## The Oxford Physic Garden

The Oxford Physic Garden, formally established in 1621, was secured through a benefaction to the university made by Henry Danvers (1573–1644), although the university had accepted the need for a 'Garden for Physical Simples' more than a year earlier.[15] Wiltshire-born, Oxford-educated Danvers, 1st Earl of Danby, was a soldier, landowner and courtier to King Charles I. Danvers's notion to create a garden in Oxford may have been inspired by the continental gardens he saw during his exile in the late sixteenth century, a desire to make a lasting mark or perhaps, with the infirmity of his later years, self-interest. Unlike early modern Italian physic gardens, the Oxford Physic Garden was never the centre of a community of workshops occupied by the tradesmen of physic – herb collectors, processors, and apothecaries.[16]

A field – a former cemetery – was rented from Magdalen College, outside the city wall, close to the River Cherwell. The walls and gates, completed by 1633, cost Danvers more than £5,000. The multipurpose garden wall, made of local limestone, marked territory and ownership, defined the garden's limits and separated Danvers's gift from the rest of Oxford (Fig. 1). The wall's grandiosity emphasized the university's prestige, at the same time protecting the enclosed area from unwelcome incursions. Besides physical protection, the wall had horticultural value as a windbreak and heat trap, helping tender plants grow and choice fruits ripen. In 1670, a 'Plantarum conditorium hyemale', for evergreens such as myrtles and citruses, was built adjacent to the Physic Garden.

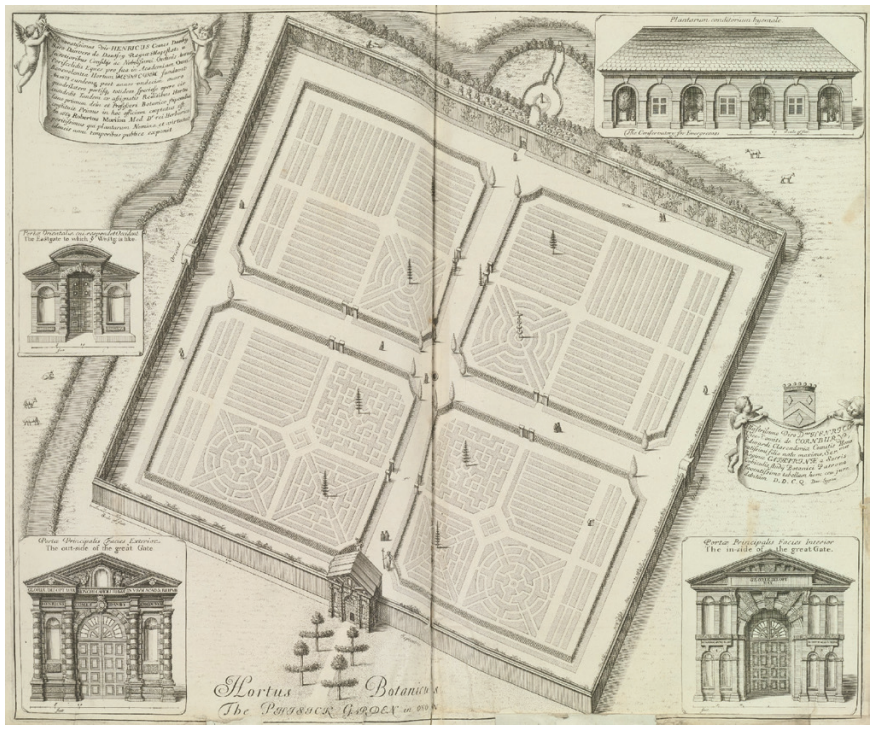


**Fig. 1.** Layout of the seventeenth-century Oxford Physic Garden, showing quartering by yew hedges and the 'Conservatory for Evergreenes' in the top right corner. Engraving from David Loggan's *Oxonia illustrata* (1675).

Eventually, this substantial building was converted to a herbarium, library and accommodation for the professor.

No gardener was associated with the Physic Garden until the late 1630s when the king's gardener, John Tradescant (d. 1638), was approached but he died before the appointment could be finalized. Jacob Bobart the Elder (*c.*1599–1680; Fig. 2), the garden's first Keeper, took up his position in 1642. We know little of Bobart, the 'Germane Prince of Plants', other than he was a tall, strong, Brunswick-born, former soldier and an eccentric publican with a penchant for topiary. Bobart married twice, had at least ten children, of which his son Jacob (1641–1719; Fig. 3) became his successor as garden Keeper. Bobart the Elder was a wealthy, literate man who, when he died, owned and leased property across Oxford, made substantial bequests to his daughters and divided his library between his sons. Despite running the garden, neither Jacob nor his son was ever a member of the university.

Danvers offered Bobart the Elder a lease, subject to his good behaviour and appropriate care for the garden; his annual salary was £40 and the income from the garden's produce.[17] With 'great Skill and indefatigable industry' Bobart established the garden, apparently to the surprise of some commentators: 'how expert a Gardener he hath showed himself'.[18] Bobart made a healthy living from his commercial interests in the city and from the garden for some decades. The Bobarts, father and son, also built a personal botanical library and herbarium to complement the living collections. Between 1669 and 1683, Bobart the Elder's horticultural activities were complemented by the appointment of a Regius Professor of Botany, the royalist Civil-War veteran, and physician to Charles II, Robert Morison (1620–1683). Morison apparently had a great influence on the physical appearance of the garden: 'Hee [Morison] shewed ym [Bobart the

**Fig. 2.** *Jacob Bobart the Elder*, oil painting by an unknown artist (Department of Plant Sciences, University of Oxford).

**Fig. 3.** *Jacob Bobart the Younger*, oil painting by an unknown artist (Department of Plant Sciences, University of Oxford).

Elder] all his designs in ye new Garden; There are to bee walks in itt of thirtie foot wide'.[19]

Morison taught in the garden, and continued the research for his *Plantarum Historiae Universalis Oxoniensis*, a new classification of the world's plants.[20] Unlike many large seventeenth-century gardens, the Oxford Physic Garden could not rely on finance from either wealthy individuals or parent organisations; Danby's substantial bequest had been spent building the garden's fabric. Until a settlement in 1734 from the will of English diplomat William Sherard (1659–1728), the university provided no regular funding for the garden's upkeep.

Oxford-born Bobart the Younger remained at the garden throughout his career. First, he worked for his father, then as keeper in his own right. Bobart maintained his father's practice of selling plants and acting as a rare-plants nurseryman for wealthy gardeners.[21] The younger Bobart was widely travelled and highly respected by scholars and gardeners in Britain and Europe. In 1659, the age of eighteen, Bobart the Younger was sufficiently well regarded to add his signature to a petition urging publication of John Evelyn's *Elysium Britannicum*.[22] When Morison was killed in 1683, Bobart took on his teaching and academic duties but not the professorial title. During the 1680s, Bobart fostered a lifelong friendship with William Sherard. Bobart was crucial in developing Sherard's botanical interests and enthusiasm for herbaria; Sherard eventually amassed 'the most ample, authentic, and valuable botanical record in the world',[23] the Sherardian Herbarium, which he bequeathed to the university. Both Bobarts are buried in the churchyard of St Peter's-in-the-East, Oxford, which now forms part of St Edmund Hall college.

Little information has survived about the activities of gardeners in the mid-seventeenth-century Oxford Physic Garden. Consequently, observations by witnesses, such as John Ward, are particularly valuable. Ward became vicar of Stratford-on-Avon but was based in Oxford between 1646 and *c*.1660. Between 1648 and 1679, he sporadically made observations in commonplace books relating to medicine and to plants. Most of Ward's botanical knowledge appears to have come from three people: Jacob Bobart the Elder, Robert Morison and Edward Morgan.[24]

## The Bobarts' catalogues and herbaria

Three plant lists were made for the Oxford Physic Garden during the seventeenth century. In 1648, an anonymous catalogue of the garden, *Catologus Plantarum Horti Medici Oxoniensis*, was published; traditionally, the author is identified as Jacob Bobart the Elder.[25] The *Catologus*'s two, unannotated, alphabetical lists, Latin–English and English–Latin, comprise 1,368 names. In 1658, the Oxford-based academics Philip Stephens (*c*.1619–1679) and William Browne (1628–1678) produced a second edition of the Catalogus. The *Catalogus Horti Botanici Oxoniensis*[26] singles out the teenaged Bobart the Younger for particular acknowledgement on the title page. In this volume, a detailed alphabetical list of 1,889 Latin names included English names and partial references to classical botanical works, although the main references are to the English works of John Gerard and John Parkinson 'out of the respect we have for our own country'.[27] There is also an incomplete alphabetical list of English–Latin names. A manuscript list of plants growing in the Botanic Garden, divided into two parts, *Catalogus Herbarum ex horto Botanico Oxoniensi* and *Altera pars Catologi ex Horto Botan: Oxon:* (dated 1676) in Jacob Bobart the Younger's hand appears to be a draft for another edition of the *Catologus*.[28] In the manuscript, 1,112 polynomials, together with English names, are enumerated; in the first part they are arranged by flowering month.

Identification based on pre-Linnaean polynomials is difficult and has been characterized as 'interpretation rather than an equation'.[29] The authors of the 1658 catalogue introduced additional confusion: 'when any plants are called by obscure or unfit names . . . the liberty [is taken] to impose [a] name of our own'.[30] Objective interpretation and comparison of the polynomials in the garden lists was possible only because of three, mid- to late-seventeenth-century herbarium collections directly associated with the Bobarts (Fig. 4): Bobart the Younger's *Hortus Siccus*; Bobart the Elder's Herbarium; and the Morisonian Herbarium.[31] Bobart the Younger's *Hortus Siccus* was evidently well-known in Oxford. In his hagiographic poem *Vertumnus* (1713), Abel Evans (1675–1737) made mention of the herbarium: 'Thy *Hortus Siccus* still receives: / In Tomes twice Ten, that Work immense! / By Thee compil'd at vast Expence; / With utmost Diligence amass'd, / And shall as many


**Fig. 4.** *Lunaria annua* specimen, probably collected from the Oxford Physic Garden, annotated by Jacob Bobart the Younger in the late seventeenth century. This species was reported from the 1648, 1658 and 1676 garden lists (Oxford University Herbaria; Mor-II-245-01).

Ages last'.[32] Bobart the Younger also contributed large numbers of specimens, and annotations, to the Sherardian Herbarium, from which specimens were abstracted in the late nineteenth century by George Claridge Druce (1850–1932) to create the Dillenian Herbaria.[33] Both Sherard and Bobart the Younger also exchanged specimens with Charles Dubois (*c.*1658–1740), cashier-general of the East India Company.[34] Together these pre-Linnaean collections comprise approximately 49,000 specimens and are preserved in the Oxford University Herbaria (Department of Plant Sciences).

Modern Linnaean names were associated with the 4,369 polynomials in the three garden lists, by putting each polynomial through a 'polynomial pipeline' (Fig. 5; Supplementary Data[35]). The pipeline emphasizes herbaria directly associated with the Bobarts (*Hortus Siccus*, Bobart the Elder's Herbarium and the Morisonian Herbarium) or which were potentially contributed to by them (Sherardian, Dillenian and Dubois Herbaria); particular attention was paid to specimens labelled by either of the Bobarts, usually the Younger. Published classification systems (those of Robert Morison and John Ray, 1627–1705), directly or indirectly associated with the Bobarts, and the unpublished manuscript of William Sherard's *Pinax*, were used to establish likely polynomial synonyms.[36] Standard illustrated works on British garden plants, published by John Gerard and John Parkinson, present in the Bobarts' personal library, were consulted.[37] As identifications became more remote from the Bobarts, or relied on descriptions or illustrations in the early modern literature, confidence in the association of a modern botanical identification with a Bobartian polynomial declined. Identification confidence was also determined by the variable quality of the herbarium specimens and the taxonomic difficulties associated with particular plant genera, e.g., *Rosa* (roses), *Rubus* (brambles), *Salix* (willows) and *Taraxacum* (dandelions). Consequently, a three-point identification-confidence scale (high, moderate, low) was applied to polynomial-Linnaean binomial association based on material quality and taxonomic difficulty (Supplementary Data, Table 1). Plants were identified as medicinal if they appeared in the 1618 *Pharmacopoeia Londinensis*, Culpeper's *A Physicall Directory* (1649) or Sutherland's *Hortus Medicus Edinburgensis* (1683).[38]

The authors of the three garden lists made use of collective polynomials, e.g. 'Pyri quam plurimae aliae species', 'Blita diversorum specierum' and 'Prunus albo diversi specii', or in the case of tulips and carnations the names were explicitly omitted since they were numerous and particular.[39] When lists were compared, names in these classes were omitted, hence the total numbers of sorts of plants grown in the seventeenth-century garden are underestimated.[40]

## What plants were grown in the seventeenth-century garden at Oxford?

Numbers of sorts are frequently used as a convenient means of comparing collections, and implying either importance or comprehensiveness. Thomas

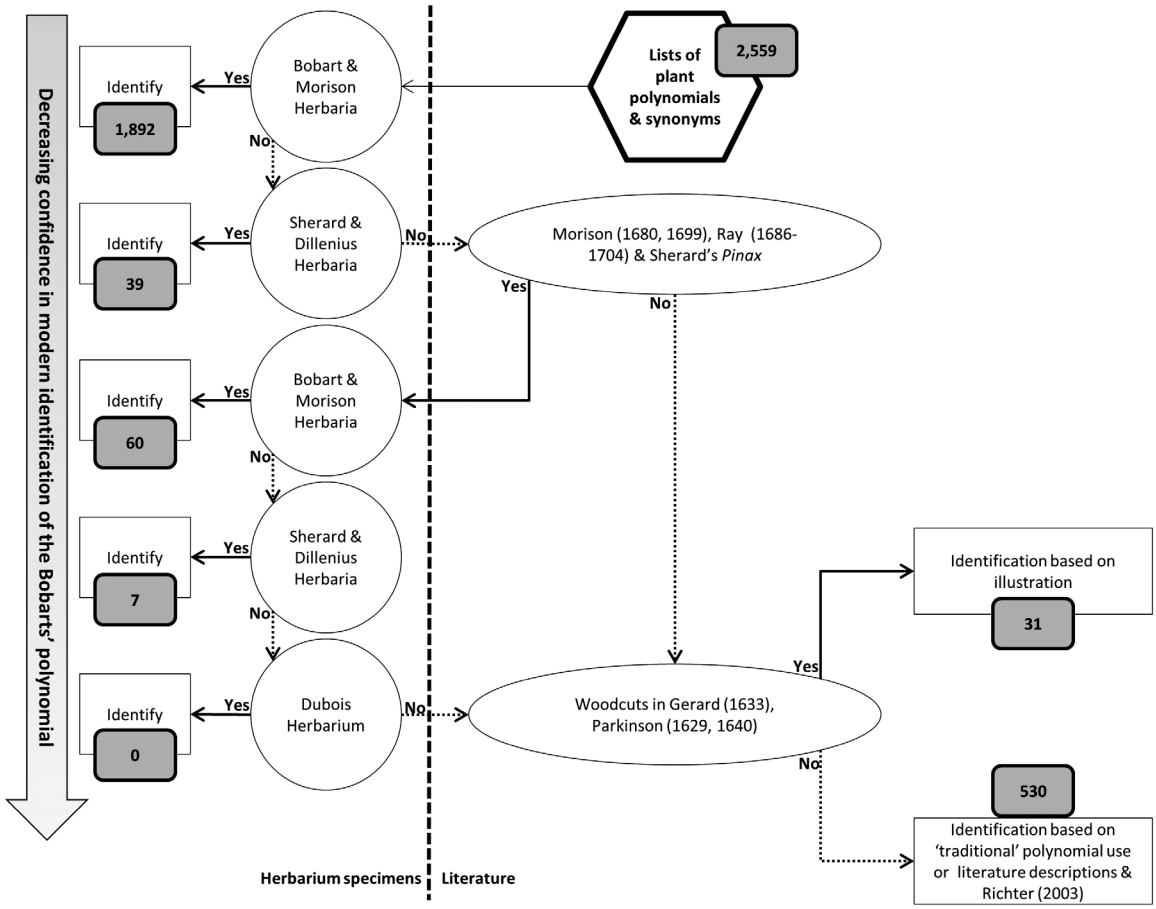


**Fig. 5.** Polynomial identification decision tree ('polynomial pipeline'). A polynomial or synonym in the three garden lists (hexagon) was compared with the labels of the Bobartian and Morisonian herbaria. If the name was present, the plant was identified; if not, the name was compared with those on labels in the Sherardian and Dillenian Herbaria. If the name was not found, synonyms for the name were searched for in published and manuscript works associated with the Bobarts. Any synonyms found were searched for in the Bobartian, Morisonian, Sherardian and Dillenian Herbaria as before; in addition the Dubois herbarium was searched. Only when these routes failed to recover a name match were illustrations or descriptions in early modern English herbals searched. The number of polynomials considered at each category is indicated in the grey rectangle. See R. Morison, *Plantarum historiae universalis oxoniensis. Pars Seconda* (1680); J. Gerard, *The Herball or Generall Historie of Plants* (1633); J. Parkinson, *Paradisi in Sole Paradisus Terrestris* (1629); W. Sherard, *Pinax* (MS. late 1600s); R. Morrison, *Plantarum Historiae Universalis Oxaniensis. Parstertia* (1699); H. E. F. Richter, *Codex Botanicus Linnaeanus* (2003).

Baskerville in his late-seventeenth-century account of the Oxford Physic Garden emphasizes the number of plants and their purpose: 'containing therein 3000 seuerall sorts of plants for y^e^ honor of our nation and Universitie and service of y^e^ Com[m]-onwealth'.[41]

In total, 2,435 polynomial names, representing at least 1,311 Linnaean taxa,[42] were reported from the garden between 1648 and 1676 (Fig. 6). Seven years after its establishment, James Sutherland reported 1,876 polynomials from the *Hortus Medicus Edinburgensis*, an area of just over one acre (0.53 ha).[43] In contrast, 1,336 polynomials (894 taxa) were reported from the five-acre (2.02 ha) Oxford Physic Garden, six years after Bobart the Elder was appointed.

Danby's intention was that the garden should grow and display medicinal plants for teaching purposes. In practice, between 1648 and 1676, at least 346 medicinal species (*c.*26 per cent of all species), such as *Aconitum anthora* (yellow monkshood) and *Nepeta cataria* (catmint), were grown in the garden (Fig. 6B). For comparison, approximately 20

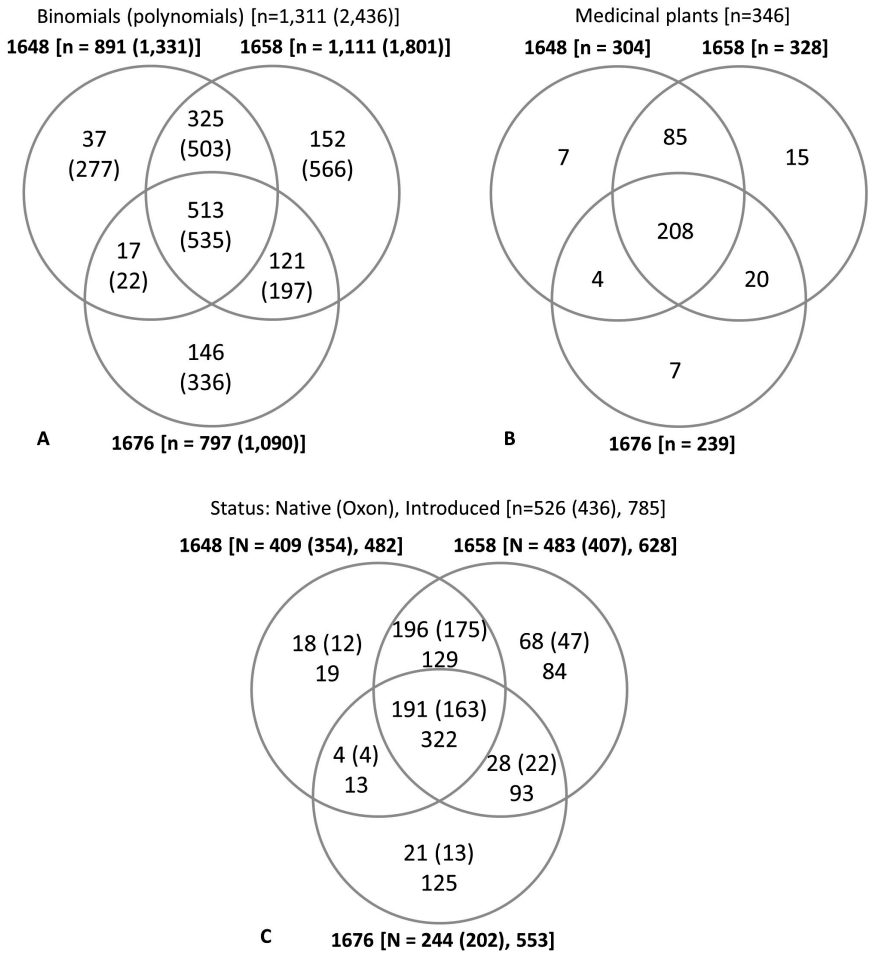


**Fig. 6.** Venn diagrams of the number of names in the 1648, 1658 and 1676 Oxford Physic Garden lists, following list editing as described in the main text. (A) Linnaean and polynomial names; (B) Medicinal plants, according to Linnaean names; (C) Native and introduced plants, according to Linnaean names. 'n' is the total number of names in each list.

per cent of all species grown in the *Hortus Medicus Edinburgensis* in 1683 were medicinal plants.[44] Bobart the Elder evidently used plants in preparations he administered to himself and his animals; 'he used in his quartane[,] Lap[athum]. Contraervae and a little posset-drink; hee took itt a little before ye fit and sweat mightily'[45], and an 'adder stung a dog of Bobarts . . . Jacob gave him white horehound and aristolochia in butter, and cured him presently'.[46] *Taxus baccata* (yew), now regarded as a medicinal plant, was used by Bobart as an ornamental.[47]

Favourite ornamentals of the period, such as *Anemone hortensis* (broad-leaved anemone; at least thirty-six types) and *Narcissus* (daffodil; at least thirty-two types), food plants, such as *Brassica oleracea* (cabbage; at least nine types) and *Lactuca sativa* (lettuce; at least five types), were elements of the garden's stock.[48] Such plants were necessary not only to provide the garden with an income but to support the Bobarts' personal horticultural interests. Bobart was evidently proud of the range of ornamentals and culinary plants he grew.[49] On 23 March 1661, Ward reports 'five sorts of fritillaries' flowering in the garden. Furthermore, 'there are 8 kinds of sorrel . . . This Jacob told mee.' Bobart the Elder was a well-known auricula breeder.[50] The vast majority of the sixty-seven polynomials (at least thirty Linnaean species) identified as unique to the Oxford Garden in 1658 are minor morphological or colour variants of widely cultivated species.

Vines and fruit trees, such as *Vitis* (grapes), *Punica* (pomegranates) and *Ficus* (figs) were probably trained against the walls.[51] John Ward reports that Bobart the Elder 'had a bunch of grapes once ripe on ye 5th. August wch. hee presented to ye Swedish Embassador' and had 'seen the double pomegranate as high as their garden wall with 500 Balaustines or flowers uppon

itt'.[52] Ward also saw 'English figs . . . ripe at ye Physic Garden September 21 1661 some were presented to ye Chancellor'. Earlier in 1661, 'almonds in ye physic garden [came] to some kind of ripeness'.[53] Bobart the Elder, a skilled grafter of trees and vines, is credited with inventing a grafting method, and managed to make the popular 'White Frontiniac' vine fruit early by grafting it onto the 'Parsly' vine.[54]

However, the Bobarts' concentration on horticultural productivity appears to have affected the garden; in 1664, during his English tour, the French physician Samuel de Sorbière (1615–1670) dismissed the garden as 'small, ill kept, and more like an Orchard than a Garden'.[55] Five years later, Cosimo III de' Medici (1642–1723), Grand Duke of Tuscany thought the Garden 'scarcely deserves to be seen' from the 'smallness of its site, irregularity, and bad cultivation'.[56]

Most plants growing in the garden could not be conveniently grouped as medicinal, ornamental or culinary since they were probably grown for their curiosity value to the Bobarts and Morison. Among the more curious seventeenth-century plants were sensitive and variegated plants.[57]

Seventeenth-century definitions of plants had changed little since Theophrastus; animals had active responses to external stimuli, whilst plants were passive. Yet sensitive plants responded to external stimuli, such as heat, touch and chemicals, by folding their leaves.[58] This heterogeneous group of plants was well known in English plant collections before Evelyn visited the Oxford Physic Garden in 1654. Charles de l'Écluse (1526–1609) first described 'Herba mimosa' from a dried specimen collected by John Layfield (d. 1617) in Puerto Rico in 1598, and Thomas Johnson (d. 1644) saw a dried herbarium specimen in 1632 as he revised Gerard's *Herball* (1597). John Tradescant the Elder had material after 1634, whilst John Parkinson saw a plant in John Danvers's (*c*.1585–1655) Chelsea garden that had been grown from seed in 1638. 'Herba sensibilis' and 'Herba humilis' from the Physic Garden were recorded in 1648 and 1658. 'Herba sensibilis' is an unidentified mimosoid legume, whilst 'Herba humilis' is *Mimosa pudica*.[59] By 1676, no sensitive plants were recorded from the Physic Garden, although Robert Morison described and illustrated six sorts in 1680.[60]

Variegated plants were of considerable interest to Morison and the Bobarts. Morison appears to have brought a variegated form of *Solanum dulcamara* (woody nightshade) to Oxford from Blois, and the collection of variegated plants, including forms of *Ilex aquifolium* (holly), *Artemisia vulgaris* (mugwort) and *Cruciata laevipes* (crosswort), gradually increased during the seventeenth century. Most of these forms were probably collected from the wild. For example, Jacob Bobart the Younger collected striped *Acer pseudoplatanus* (sycamore) from the grounds of Madgalen College, and it was part of the garden collection by 1676.[61]

The majority of Linnaean species grown in the seventeenth-century garden were primarily Eurasian introductions (785 species; 59.9 per cent; Fig. 6C). These introductions included species such *Calendula officinalis* (garden marigold), which had been part of British gardens for centuries. Others, such as North American *Oenothera biennis* (evening primrose), were more recent introductions to Britain. Among the 526 British native species grown in the garden, 436 (82.9 per cent) were native to Oxfordshire, which is more than half of the native flowering plants recognized in Oxfordshire today.[62] As might be expected, given the garden's location, many marshland and aquatic plants were reported from the garden, including *Butomus umbellatus* (flowering rush), *Groenlandia densa* (opposite-leaved pondweed) and *Hottonia palustris* (water violet). Surprisingly, the native plants reported as growing in the garden included parasites such as *Lathraea squamaria* (toothwort) and *Orobanche rapum-genistae* (greater broomrape); these species are more likely to have been adventives rather than specifically cultivated. Similarly, fungi, lichen, mosses and liverworts reported from the garden are unlikely to have been actively cultivated.

The rigorous approach to identification adopted here means 498 polynomials (20.5 per cent) of the polynomials remain unidentified to species rank because specimens were never collected, have been lost or decayed, or lack essential parts necessary for reliable identification. In some cases, the failure is because a polynomial cannot be linked with a single Linnaean species. For example, Bobart the Younger uses the name 'Rhus Virginiana' to label herbarium specimens of both *Rhus typhina* and *Rhus copallinum*.[63]

By 1675, the Oxford Physic Garden was divided into gated quarters, presumably hedged with yew, with a conservatory outside the north wall (see Fig. 1). Despite detailed knowledge of the garden's overall appearance and of the species growing in it, one

can only speculate upon how plants were arranged in the garden's beds. John Evelyn suggested two methods for the arrangements of academic gardens; 'confusedly, & according to their severall aspects & soile',[64] or alphabetically. Evelyn recommended the 'confused' approach, combined with labelling plants using numbered, lead tallies matching numbers in an '*Album memoriae* which should be a Booke purposely designed for Garden [*sic*], wherein they may be entered in Alphabeticall Catalogues, referring to their severall situations, beds, & places.'[65]

However, alternative arrangements were available. In the *Hortus Medicus Edinburgensis*, Sutherland arranged plants into six plots.[66] Two plots were ordered according to Gaspard Bauhin's *Pinax* (1623), a third plot contained garden ornamentals and a fourth comprised alphabetically arranged medicinal plants. A fifth plot included a pond and a small nursery, whilst the final plot was devoted to woody plants. The arrangement of four quarters in the Oxford Physic Garden is reminiscent of a world divided into four continents, as in the frontispiece to Parkinson's *Theatrum Botanicum* (1640).[67] Given the close association of the garden with Morison's classification system from 1669, it is tempting to assume that this system was adopted in the garden. Unfortunately, Morison's classification was never completed and the first published part appeared only in 1680. If any classification-based arrangement were adopted it is more likely to have been that of Bauhin, as followed in Edinburgh.

## How did the plants grown change during the century?

As might be expected for a fledgling garden, in an academic institution, there was change in the garden's contents between 1648 and 1676. The living collection increased through the acquisition of species not previously grown or new forms of species already growing. The collection decreased when species died because of pests and diseases or the discovery that conditions were inappropriate for them to flourish. Approximately six years after Jacob Bobart the Elder took up his post, at least 894 species (1,336 polynomials; Fig. 6) were growing in the garden. A decade later, there were at least 1,111 species (1,801 polynomials). Nearly twenty years after that, Bobart the Younger recorded at least 797 species (1,090 polynomials) in the garden. Throughout this period 513 species (39.2 per cent of all species; 535 polynomials) were grown continuously, including 208 medicinal plants (60.1 per cent of all medicinal species), e.g., *Bellis perennis* (daisy), *Santolina chamaecyparissus* (cotton lavender) and *Punica granatum* (pomegranate).

At least 37 species (2.8 per cent of all species; 277 polynomials) were unique to the 1648 list, including seven medicinal plants, e.g., *Asplenium adiantum-nigrum* (black spleenwort), *Cymbopogon schoenanthus* (camel's hay), and *Prunus spinosa* (blackthorn). At least 152 species (11.6 per cent of all species; 566 polynomials) and 146 species (11.1 per cent of all species; 336 polynomials) were reported only from the 1658 and 1676 lists, respectively. Unique records are species the Bobarts failed to maintain between census dates or which were overlooked/ ignored by different recorders (e.g., the moss *Thuidium tamariscinum*), although in the case of the 1676 list we do not know how many of these species went on to survive in the garden. Surprisingly, *Viscum album* (mistletoe) was reported in 1648 but not in later lists, whilst among the more unusual, and less surprising, 1658-list species which did not survive were the African/Indian *Tamarindus indica* (tamarind) and the North American *Toxicodendron radicans* (poison ivy).

The Bobarts evidently retried, by 1676s, cultivating seventeen species (1.3 per cent of all species; twenty-two polynomials) from the 1648 list, which had been absent from the 1658 list. Among these species were four medicinal plants, *Paeonia mascula* (male peony), *Paeonia officinalis* (common peony), *Primula vulgaris* (primrose) and *Salvia sclarea* (clary sage). Six species are surprising inclusions in this list. *Aegopodium podagraria* (ground elder) is probably a Roman introduction to Britain and a widespread and persistent weed. Four species, *Geranium columbinum* (long-stalked crane's bill), *Primula vulgaris*, *Stellaria holostea* (greater stichwort), *Veronica arvensis* (wall speedwell), are Oxfordshire natives and likely to have been widespread in the Bobarts' time, whilst *Triticum aestivum* (bread wheat) was a common seventeenth-century crop.

When Morison took up his post in Oxford (1669), he was ambitious to expand the garden's living collection but limited by resources: '[Edward] Morgan told mee [Ward] of a person [Morison] yt hee knew yt would undertake to raise 500 plants more yn ever was in England in one or *2* yeeres if hee had but

Incouragement'.[68] Familiar ornamental and culinary plants were likely to have been available from commercial seedsmen and nurserymen.[69] However, for more unusual plants, the Bobarts and Morison had to look elsewhere. Morison was aware of the expense of trying to stock a garden with unusual plants from his time in exile in France: 'ye Duke of Orleance sent but 4 persons with 4 men and horses to seek out strange plants . . . they found but 3 very strange plants and yt voyage cost ym more – ye Duke – Dr. Modesay thought, yn all ye Gardens [Blois] did beside'.[70] Such elaborate plant-hunting expeditions were unaffordable for a garden with a limited budget supplemented by the sale of produce in Oxford.

The Bobarts and Morison had to be content with more modest collecting expeditions and enlisting personal and institutional contacts across Europe to fill the garden. The networks of botanical exchange involving the Oxford Physic Garden in the seventeenth century have yet to be explored in detail. However, it is clear that plants arrived in the Physic Garden through a diverse set of routes. The Bobarts undertook simpling expeditions in Oxfordshire and surrounding English counties.[71] For example, Bobart the Younger grew a white-fruited bramble he had spotted near Oxford,[72] whilst in 1658 a specimen of *Cynoglossum germanicum* (green hound's-tongue) was grown which was 'bought from Reading, where it was shewed us by Mr Watlington'.[73]

Internationally, Bobart the Younger was in contact with Pierre Magnol (1638–1715) in Montpellier via John Locke, whilst Paulo Boccone (1633–1704) supplied Robert Morison with Sicilian plants.[74] The Bobarts were also exchanging plants with Guy-Crescent Fagon (1638–1718), Jardin Royal des Plantes Médicinales, Paris, and William Sherard would develop extensive contacts with Leiden in the late seventeenth century.[75]

## How was the garden used?

Danby and the university's conceptions of the Oxford Physic Garden were as a space for growing medicinal plants to aid medical teaching and research. However, under the Bobarts, medicinal plants formed a small part of the living plant collection. The first formal lecture in the garden took place on 5 September 1670, when the newly inaugurated Robert Morison stood in the centre of the walled garden and talked about plant classification.[76] Morison was apparently an engaging teacher, although he spoke at a 'gallant rate' and had 'no command of the English, as being much spoyled by his Scottish tone'.[77] His lectures became more sporadic as he focused on the research for his *Historia*.

During their time some teaching about medicinal plants was undertaken by the Bobarts based around the garden.[78] In 1658, Stephens and Browne justified publication of their catalogue to the garden because of 'solicitations of students in Physick & lovers of plants'.[79] However, equal – if not more – interest appears to have been associated with the need to generate income and the science of describing plants and classification systems.

The Bobarts were highly skilled, experimental gardeners interested in anything that might increase income, for example, grafting techniques, nutrient regimes and novel plant selection. Ventures into more philosophical aspects of plant biology proved less successful. For example, they asserted, with authority given their horticultural reputations, that, if left in the soil, 'Crocus' changed into 'Gladiolus'.[80]

Bobart the Younger's horticultural observations led him to suggest single-flowered and double-flowered carnations could be differentiated before they flowered. If true, 'beautiful and profitable' double forms could be cheaply screened from commonplace single forms.[81]

The Bobarts made observations relevant to plant sex, a controversial idea in the seventeenth century,[82] but never formalized their conclusions. Bobart the Younger found a white campion with flowers that lacked male parts, and he was aware plants such as cannabis had individuals that did and did not produce seed.[83] As curators, the Bobarts were enthusiastic sharers of botanical knowledge, contributing to national and international scientific networks. Towards the end of his life, Bobart the Younger was even prepared to sacrifice part of his own herbarium to maintain his relationship with James Petiver (*c*.1665–1718) at the Chelsea Physic Garden.[84]

By the end of the seventeenth century, catalogues of the Bobarts' plants were being offered for sale and have been credited with founding seed exchange schemes, although in fact such schemes were established practice among seventeenth-century botanists and gardeners.[85]

Despite criticisms of the garden's appearance, the university continued to parade distinguished visitors, such as the Prince of Orange (future King William

III; 1650–1702), through it.[86] Gentlemen, such as John Evelyn and Elias Ashmole (1617–1692), praised both it and the Bobarts.[87]

The work on stocking the Oxford Physic Garden did not begin until the appointment of Jacob Bobart the Elder in 1642, despite completion of the walls in 1633. Between 1648 and 1676, the garden the Bobarts filled with more than 1,300 Linnaean species was closer to Evelyn's concept of a 'Philosophico-Medical Garden' than a collection of plants focused on medical training.[88] The ornamental and food plants grown by the Bobarts were probably essential to maintaining an income for the garden. However, the vast majority of the plants growing in the garden were of botanical interest only and illustrated some of the diversity of plants being imported into Britain that could be grown in a temperate climate; few of the species cultivated needed year-round indoor protection.

## Supplementary information

A catalogue linking polynomials and modern binomials, together with all herbarium specimens used to determine the links, is provided at *Oxford Journals online*.

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## Acknowledgements

I am grateful to Anna Svensson for valuable comments on the paper manuscript and the following collections for access to manuscripts and specimens: Sherardian Library of Plant Taxonomy, Bodleian Library, the British Library and Oxford University Herbaria. I thank the Department of Plant Sciences, University of Oxford for permission to use images of the portraits of Jacob Bobart the Elder and Jacob Bobart the Younger.

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30 See Stephens and Browne, op. cit. (note 9), preface 'to the Philobotanick Reader'.

31 Bobart the Younger's *Hortus Siccus* comprises 2,202 specimens mounted on individual sheets and filed according to Morison's *Sciagraphia*. The contents of this collection have been briefly described by S. A. Harris, 'Bobart the Younger's *Hortus Siccus*', *Oxford Plant Systematics* 13 (2006), pp. 10–11. The date of this collection is unknown. Vines and Druce, op. cit. (note 10), based on circumstantial evidence, suggest the collection may have been made around 1666. Bobart the Elder's herbarium is a single, leather-bound, elephant-folio book herbarium of *c.*2,800 specimens, arranged alphabetically by polynomial name. This collection was re-acquired by the university in the early 1950s: see S. Savage, 'A book herbarium made by Jacob Bobart 1660', *Proceedings of the Linnean Society of London* 160 (1948), p. 55. On the pastedown of the inside back cover is a note stating 'Octob: 6: 1687 the number of Plants in this was 2577'. Despite its name, the Morisonian Herbarium was put together by Jacob Bobart the Younger to support Part III of Morison's *Plantarum Historiae Universalis Oxoniensis* and is arranged according to Morison's *Sciagraphia*. The collection comprises some 6,500 specimens mounted on individual sheets and has been documented by Vines and Druce, op. cit. (note 10).

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34 H. N. Clokie, *An Account of the Herbaria of the Department of Botany in the University of Oxford* (Oxford, 1964).

35 Complete catalogue linking polynomials and modern binomials, together with all herbarium specimens used to determine the links, is provided as Supplementary Data.

36 Morison's *Plantarum Historiae*, extensively illustrated with black-and-white engravings, was to have been published in three volumes. Volumes II and III were published by Morison in 1680 and Bobart the Younger in 1699, respectively. Volume I was never published, although a manuscript of its contents, in Jacob Bobart the Younger's hand, is preserved (Sherardian Library of Plant Taxonomy, Bodleian Library, MS Sherard 34). Sherard's *Pinax* (Sherardian Library of Plant Taxonomy, Bodleian Library, MS Sherard 44–173) is a listing of polynomial synonyms started by William Sherard at the end of the seventeenth century and annotated by subsequent Sherardian Professors until the end of the eighteenth century, see S. A. Harris, 'William Sherard: his herbarium and his *Pinax*', *Oxford Plant Systematics* 21 (2015), pp. 13–15.

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38 In the absence of detailed descriptions or illustrations in these texts, broad definitions of the medicinal plants being referenced have been used. J. Sutherland, *Hortus Medicus Edinburgensis, or, a catalogue of the plants in the Physical Garden at Edinburgh* (Edinburgh, 1683). F. W. Robertson, 'James Sutherland's 'Hortus Medicus Edinburgensis' (1683)', *Garden History* 29 (2001), pp. 121–51.

39 See Anonymous, op. cit. (note 25). See Stephens and Browne, op. cit. (note 9), Preface 'to the Philobotanick Reader'.

40 Following omission of collective polynomials there were 1,336, 1,800 and 1,090 polynomials in the 1648, 1658 and 1676 lists, respectively, giving a total of 4,226 unique polynomials. Inspection of the three herbaria revealed hundreds of specimens, probably from the garden, of taxa not reported in the garden lists.

41 See Vines and Druce, op. cit. (note 10), p. xiii.

42 'Species' or 'taxa' in the Garden refer to Linnaean species or taxa. Taxonomic entities recognized by the Bobarts are referred by their polynomials or as 'sorts'.

43 See Robertson, op. cit. (note 38). It is unclear to how many Linnaean binomials are represented by these polynomials.

44 See Robertson, op. cit. (note 38).

45 See Power, op. cit. (note 3), p. 121. This name is not recorded in the garden catalogues and does not appear on specimens in the *Hortus Siccus*, the Morisonian herbarium or Bobart the Elder's herbarium.

46 See Severn, op. cit. (note 11), p. 277.

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48 R. Duthie, *Florists' Flowers and Societies* (Princes Risborough, 1988).

49 See Power, op. cit. (note 3), p. 117–18.

50 J. Rea, *Flora, seu, de Florum Cultura, or, a Complete florilege: Furnished with all the requisites belonging to a florists. In III books* (London, 1665). Named auricula cultivars are found in Bobart the Elder's Herbarium (BSN-A33r, Oxford University Herbaria).

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