LARGE PRINT CAPTIONS

ROOTS TO SEEDS

400 YEARS OF OXFORD BOTANY

PLEASE RETURN AFTER USE

Curator’s audio guide

Listen to Professor Stephen Harris explore highlights from the exhibition.

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To listen to the exhibition introduction scan this QR code

You are welcome to use your device with or without headphones.

Plants are essential to all aspects of our lives. They feed, clothe and shelter us, and provide us with drugs, medicine and the oxygen we need to survive. Moreover, they have key roles in resolving current global problems such as food security, environmental change and sustainable development.

This summer marks the anniversary of the foundation of the Oxford Botanic Garden, in 1621, and offers an opportunity to reflect on four centuries of botanical research and teaching in the University.

Botany in Oxford, as we will see in this exhibition, has not enjoyed steady growth. Activity has been patchy; long periods of relative torpor, punctuated by bursts of intensely productive activity. The professors and researchers who have worked in Oxford have contributed to startling advances in our knowledge of plants, but they also found themselves held back by circumstance – their own, the societies in which they lived, or by the culture of the University.

The roots of Oxford botany are in its collections of specimens and books, which remain central to modern teaching and research. From these collections, buds of new investigation sprout and flower, perhaps fruiting as botanical knowledge that can be used to solve global problems. Eventually, seeds of new ideas and, importantly, trained students are dispersed to become established in industry, institutions and governments around the world.

The last 400 years has shown that plant sciences at Oxford succeeds by focusing on quality research and teaching. Modern plant scientists are equipped with the tools they need to frame and answer new questions about the biology of plants that address current and emerging global challenges. Today, the role of plant scientists in society has never been more important.

Origins

Until the 1500s, botanical knowledge was frequently evaluated with reference to Roman and Greek authorities rather than to nature. Consequently, botanical texts and illustrations became remote from living plants. Gradually, as Europeans explored new continents, handed-down authority became insufficient to describe the natural world. During the seventeenth century, a new natural philosophy became firmly rooted in Oxford University, especially through scholars' strong associations with the fledgling Royal Society. In 1620, the University made 'motions ... for the founding of a ... Garden for Physical Simples' to support the teaching of medicine. By the end of the century, the University had a flourishing Physic Garden that bore comparison with the best in Europe, and an intellectual environment to match.

1. Mythical Mandrake

Mandrake (*Mandragora officinarum*) is an important Mediterranean medicinal plant, although few plants in Western botany are surrounded by as much folklore. When the homunculus-like root was ripped from the ground, some believed that it screamed – killing the person uprooting it. Incantations with swords and magic circles might protect harvesters, although a better method for harvesting was to use a dog which would die before its master; pre-Renaissance mandrake illustrations often come with a canine companion.

Stylized mandrake from the 'Pseudo-Apuleius herbal' from St. Augustine's Abbey, Canterbury (c. 1070–1100)
MS. Ashmole 1431

2. Understanding Mandrake

As a medicinal plant, extracts of mandrake (*Mandragora officinarum*) produce drowsiness, anaesthesia, hallucinations or death, depending on dosage. If mandrake is to be used safely, users must realize that individual plants produce different amounts of alkaloid depending on when, where and how they are grown and harvested. Mandrakes were among the first plants grown in the Oxford Physic Garden, as knowledge about plants began to come from practical observation rather than from received wisdom.

Watercolour of mandrake (*Mandragora officinarum*), made in Oxford between 1788 and 1792 by Ferdinand Bauer and based on his sketches made in the eastern Mediterranean in 1786/87
MS. Sherard 244 (Sherardian Library of Plant Taxonomy)

3. Drawn from Nature

Three artists spent over a decade drawing plants and preparing more than 500 woodcuts for the sixteenth-century German physician Leonard Fuchs's *De historia stirpium commentarii insignes* (1542). This herbal was among the first to include illustrations drawn from nature, rather than merely copied from earlier books and manuscripts. The artists who made the illustrations were specifically credited: Albrecht Meyer drawing a plant; Heinrich Füllmaurer transferring a drawing to a woodblock; and Veit Rudolph Speckle cutting the block.

Artists illustrating Leonard Fuchs's *De historia stirpium commentarii insignes* (Basel, 1542)
Sherard 646 (Sherardian Library of Plant Taxonomy)

4. Full of Errors

The *Herball* of 1597, by a barber-surgeon based in Holborn, was a book full of errors: describing plants known in late-sixteenth-century England, it was illustrated with woodcuts copied from earlier publications. Many of Gerard's misconceptions were eliminated in the expanded second edition, edited by apothecary Thomas Johnson (c. 1595–1644) and published in 1633. The second edition, known as 'Gerard emaculatus', was one of the standard reference works in English used by the Bobarts as they began stocking Oxford Physic Garden.

John Gerard, The Herball or Generall Historie of Plantes (London, 1597)
Sherard 649 (Sherardian Library of Plant Taxonomy)

5. Looking at Oxfordshire

In his *The natural history of Oxford-shire* (1677), Robert Plot, the first keeper of the Ashmolean Museum, gave rational, detailed, evidence-based descriptions of objects and phenomena. One of his sources of botanical data about the plants of Oxfordshire was Jacob Bobart the younger, the second superintendent of the Physic Garden. Plot believed experimentation was essential to understand the natural world.

Map of Oxfordshire from Robert Plot's *The natural history of Oxford-shire* (Oxford, 1677)
Sherard 564, (Sherardian Library of Plant Taxonomy)

6. Oxford's Physic Garden

Oxford Physic Garden was officially founded on 25 July 1621 on a flood-prone meadow leased from Magdalen College. The founding gift of £5,250, made by the English soldier Sir Henry Danvers, earl of Danby, was spent on the Garden's walls and the 'mucke' to improve its soil. Founded with a focus on medicinal plants, the Physic Garden became the stage upon which plant sciences evolved in the University for nearly 350 years.

The Physic Garden from David Loggan's *Oxonia illustrata* (Oxford, 1675)
Vet. A3 b.21

7. Jacob Bobart the elder (*c.* 1599–1680)

Jacob Bobart the elder, the 'Germane Prince of Plants', was a soldier before settling in Oxford. In 1642 Bobart became the first superintendent of the Physic Garden. He was tall, strong and literate, with a reputation for being able to 'hold his own among the dons of the university'. Together with his son Jacob, he is commemorated in the name *Bobartia*, a genus of South African plants in the iris family.

Portrait thought to be of Jacob Bobart the elder (c. 1599–1680)
Unknown artist (Department of Plant Sciences)

BOBART THE ELDER'S HERBARIUM

The slow evolution of collections, from cabinets of curiosities to carefully curated and labelled groups of objects that could be used to address scientific botanical questions, began in Oxford in the latter half of the seventeenth century. As Bobart the elder and Bobart the younger expanded the living collection at the Physic Garden, they also created a private library of dried, preserved specimens – a herbarium – from plants in the Garden and from the countryside around Oxford.

8. Hemp and Chillies

This leather-bound volume is the foundation of the University's botanical collections. It comprises some 2,800 specimens arranged alphabetically by a Latin phrase name (polynomial) with annotations. It bears the inscription: 'Octob: 6: 1687 the number of Plants in this was 2577'. The Bobarts' reasons for creating a herbarium are unknown. Perhaps they realized specimens were essential links with catalogues of plants growing in the seventeenth-century Garden.

Specimens of hemp (*Cannabis sativa*) and chillies (*Capsicum*), late seventeenth century
Bobart the elder herbarium (Oxford University Herbaria)

WILLIAM SHERARD'S *PINAX*

By 1600, scientists (called 'natural philosophers') had published tens of thousands of plant names. Gaspard Bauhin's *Pinax theatri botanici* (Basel, 1623) became crucial for enabling people to communicate accurately and scientifically about plants, but by the end of the century it was inadequate. At the Jardin du Roi in Paris, Joseph Pitton de Tournefort thought William Sherard had the intellectual and personal qualities to revise Bauhin's work. Sherard's *Pinax* (register) was an attempt to catalogue all known plant names. It was the most ambitious botanical research associated with Oxford until the nineteenth century.

9. A Monumental Distraction

Sherard formed the catalogue around Bauhin's *Pinax*, adding thousands of entries by combing collections for novel names. Asessments were made about whether these were new species or mere synonyms. The project lasted nearly ninety years. It occupied the last decades of Sherard's life, and the careers of Johann Dillenius and Humphrey Sibthorp. The 6,215 densely packed, handwritten pages of the *Pinax* are a testament to the Sisyphean task which began with Sherard and died with Sibthorp. With hindsight, the devotion to the *Pinax* after Sherard's death turned out to be a distraction from European botanical developments.

A small selection of notebooks comprising Sherard's *Pinax*, eighteenth century (Sherardian Library of Plant Taxonomy

NAMING AND CLASSIFYING

Research concerned with naming and classification has been a consistent feature of botany in the University since the seventeenth century. Accurate names are central to the uses we make of plants, whilst accurate communication about plants' properties depends on giving them unique names. In the seventeenth century, natural philosophers used a system of short Latin descriptions (polynomials). The eighteenth-century Swedish botanist Carl Linnaeus formalized the system of binomial naming (in two parts) used today. However, even when plants are given names, alphabetical lists contain limited botanical information – classification systems are essential. Experimentation with methods saw lists arranged according to habit, habitat and use, before shifting to systems based on reproductive parts, e.g. flowers and fruits. These crystallized in the sexual classification system of Linnaeus, an initially controversial system viewed with scepticism by the first Sherardian professor, Johann Dillenius. Today, classification systems are based on DNA characters.

10. The Garden's First Catalogue

The first catalogue of plants growing in the Physic Garden, the *Catologus Plantarum Horti Medici Oxoniensis* (1648), is traditionally attributed to Jacob Bobart the elder. The Physic Garden contained a diverse array of British and European plants, showing it was more than a collection of medicinal plants. Many of the *Catologus'* 1,368 plant names can be matched to modern names, by comparison with herbarium specimens collected by the Bobarts. A second edition of the catalogue was published in 1658.

Title page of Anonymous (Oxford, 1648) *Catologus sic Plantarum Horti Medici Oxoniensis*
Sherard 23 (Sherardian Library of Plant Taxonomy)

11. Arranged by Use

As Bobart the elder established the Physic Garden, many of the botanical reference books he used, such as John Parkinson's *Paradisi in Sole* (1629) and John Gerard's *The Herball* (1633), arranged plants by value to people rather than by features of the plant. For example, in William Coles's *Adam in Eden* (1657) plants were arranged according to the doctrine of signatures, where a plant's medicinal uses were divined from its appearance, for example, iris roots revealed a plant's efficacy against tumours.

William Coles, *Adam in Eden: or, Natures paradise* (London, 1657) with marginal sketches and hand-coloured woodcuts clipped from Rembert Dodoens' *A Nievve Herball* (London, 1578)
Sherard 424 (Sherardian Library of Plant Taxonomy)

12. The ‘Lower Plants’

In Oxford, Johann Dillenius returned to his interest in ‘lower plants’, i.e., mosses, lichens and algae, which he ‘discovered and sorted out with stupendous industry’. Here he produced his most original scientific work, the *Historia muscorum* (1741). In eighty-five plates drawn and engraved by himself, Dillenius attempted to bring order to the botanical confusion surrounding ‘lower plants’. Dillenius’ foresight in associating descriptions with herbarium specimens contributed to the continuing importance of the *Historia*, especially for the study of lichens worldwide.

Copperplate engraving of lichens by Johann Dillenius, based on his own illustrations, for his *Historia muscorum* (Oxford, 1741)
Sherard 441 (Sherardian Library of Plant Taxonomy)

13. Collecting and Categorizing

Johann Dillenius collected ‘lower plants’ from across Britain as he built an enviable research herbarium. Through networks of collaboration, he added samples from across Europe, Russia, Greenland, the Thirteen Colonies of North America, the Caribbean, and even Patagonia. As he sought to understand genera (categories of plants), Dillenius examined specimens at the limits of the technology available to him. Carl Linnaeus dedicated his *Critica botanica* (Leiden, 1737) to Dillenius, stating ‘there is nobody in England who understands or thinks about genera except Dillenius’.

Herbarium specimens of the liverwort genus *Marchantia* used by Johann Dillenius when he wrote *Historia muscorum* (1741)
HM_166 (Oxford University Herbaria)

14. Collected in the Garden

Bobart the younger's *Hortus Siccus* comprises 2,202 specimens mounted on individual sheets and arranged according to Robert Morison's fruit-based classification system. Bobart probably collected this specimen in the Physic Garden. He labelled specimens with a polynomial name ('Pastinaca tenuifolia sylvestris, sive Daucus officinarum' 'Wild narrow-leaved parsnip or officinal carrot') and a common name ('Wild Carret'). Living plants in the Garden would have been important for Morison's investigations of fruit structure.

Specimen of wild carrot (*Daucus carota*), probably collected in the Oxford Physic Garden, c. 1666
BJr-10-067 (Oxford University Herbaria)

15. All About Carrots

Robert Morison planned a catalogue of the world's plants, called the *Plantarum Historiae Universalis Oxoniensis*, classified according to 'fruit' characters he observed in nature. To garner enthusiasm for his scheme, Morison first produced this book, an account of the carrot family. What Morison offered was an accessible, superbly illustrated, coherent classification system to the 'great satisfaction of the Learned, both at home and abroad'. Today, *Plantarum umbelliferarum* is considered the first taxonomic monograph – a detailed account of a coherently defined group of species.

Plate of 'TABULA GENERALIS ICONUM SEMINUM UMBELLARUM' from Morison's *Plantarum umbelliferarum distributio nova* (Oxford, 1672: Tab. 1. Icon), sponsored by Peter Mews, Vice-Chancellor of the University of Oxford
Sherard 726 (Sherardian Library of Plant Taxonomy)

16. Sketched in Mediterranean – Finished in Oxford

Botanical illustrations have been fundamental to botanical research in Oxford since the seventeenth century. The best-known botanical illustrator associated with Oxford is Ferdinand Bauer (1760 – 1826) who arrived at Oxford in late 1787, in the employment of John Sibthorp, the third Sherardian Professor. Bauer set to work transforming sketches made during their exploration of the eastern Mediterranean into some of the world's finest botanical illustrations. These watercolours were eventually published in the *Flora Graeca*, one of the most expensive botanical books ever written.

Watercolour of *Daucus guttatus*, made by Ferdinand Bauer in Oxford, based on sketches made in the eastern Mediterranean in 1786/87
MS. Sherard 242 (Sherardian Library of Plant Taxonomy)

17. Food, spice and poison

In addition to carrots, parsnips and celery, the carrot family includes many herbs and spices such as coriander, cumin and parsley. Confusion among species in the family may be deadly, as it also includes highly toxic plants such as hemlock – the poison that killed Socrates. Within the family, many of the major groups are distinguished primarily by the detailed structure of their fruits.

Hermann Zippel and Carl Bollman's *Repräsentanten einheimischer Pflanzenfamilien*, 1880s
Uncatalogued (Oxford University Herbaria)

18. The Sexual System of Classification

In the 1730s, Carl Linnaeus proposed a plant classification system based on the numbers of a plant flower's male and female parts. The classification, which became known as the Linnaean sexual system, divided plants into 24 groups. The system established itself in British botany, but it was not until the 1780s, decades after it was first proposed, that Oxford adopted the system – together with Linnaeus' binomial naming system.

Night-blowing cereus (*Selenicereus grandiflorus*) from Robert Thornton's idiosyncratic *Temple of Flora* (London, 1807), an attempt to illustrate the principles of Linnaean botany. The mezzotint was made by Robert Dunkerton, based on an original oil painting by Philip Reinagle and Abraham Pether
582 Ll 13 (Sherardian Library of Plant Taxonomy)

COLLECTING

All plant biologists rely on data from collections. These include collections of dried plants from herbaria; living plants from gardens or experimental trials; seeds or cell cultures from germplasm banks; DNA, RNA and protein sequences from databases; experimental data sets; and books, journals and manuscripts. Collections are stores of evidence – empirical data (the facts) – from which information can be distilled, and scientific ideas generated and tested, from past through the present to the future. They represent intellectual capital which evolving philosophical, technological and analytical frameworks can use to investigate novel questions about plants. Some of the University's botanical collections provide data that extend back at least four centuries. They are also rich in the quantity, quality and geographical extent of the data they contain.

19. Ample, Authentic and Valuable

The University's collection of over one million herbarium specimens is concentrated in the Oxford University Herbaria. This Jamaican chocolate tree (*Theobroma cacao*) specimen comes from the herbarium of William Sherard, which was donated to the University in 1728. Sherard's herbarium has been described as 'the most ample, authentic, and valuable botanical record in the world', rivalling that of his contemporary Hans Sloane whose collections founded the British Museum.

Herbarium specimen of cocoa (*Theobroma cacao*) collected in Jamaica, from William Sherard's personal herbarium
Sher-1580 (Oxford University Herbaria)

20. Reuse, Recycle

Collections are created and maintained at great cost. In the field, collectors must carry everything with them, including paper to dry specimens. Paper however is not only heavy, but expensive. Therefore, it must be reused. Drying absorbent papers used to press specimens is slow and laborious. These papers are also used to pack specimens for their safe return to a collector's home, where paper may then find a new life – such as in this binding for one of the volumes of William Sherard's *Pinax*.

Binding of Sherard's Pinax showing the reuse of the paper used to dry a specimen of *Theobroma cacao*; MS. Sherard 56 (Sherardian Library of Plant Taxonomy)

21. Dry it, or Draw it

Some organisms are difficult to preserve as dried specimens. They collapse on drying, losing their form. They may be very susceptible to attack by insects and fungi. In such cases, illustrations may be used as surrogates for specimens. This watercolour of a basket stinkhorn (*Clathrus ruber*) is part of a 'paper museum' Johann Dillenius used to study fungi.

Basket stinkhorn (*Clathrus ruber*) from Bruno Tozzi's *Sylva fungorum* (1724) MS. Sherard 197 (Sherardian Library of Plant Taxonomy)

22. Preserved Fruit

Labelled, flattened, dried specimens mounted on pieces of card provide fundamental information about the date, place and identity of plants. However, not all plants are easily preserved by pressing. The parts may remain very bulky, or drying may destroy characteristics that are important for their use in research. Dried fruits are kept in a separate fruit collection, fleshy fruits and orchid flowers may be preserved in alcohol, and DNA extracted and preserved in cold storage.

Selection of dried fruits associated with specimens in Oxford University Herbaria (Oxford University Herbaria)

1. Grapple plant (*Harpagophytum procumbens*, South Africa)

2. (*Dipterocarpus applanatus*, North Borneo)

3. (*Dipterocarpus kunstleri*, North Borneo)

4. Gaping Dutchman's pipe (*Aristolochia ringens*, Nigeria)

5. (*Couratari oblongifolia*, Brazil)

6. Tonka bean (*Dipteryx alata*, Beliza)

7. Rosary pea (*Abrus precatorius*, Seychelles)

8. Cola (*Sterculia oblonga*, Ghana)

9. Honduras mahogany (*Swietenia humilis*, Nicaragua)

10. Wild calabash (*Crescentia alata*, Nicaragua)

11. Sausage tree (*Kigelia Africana*, Uganda)

12. African tulip tree (*Spathodea campanulata*, Nigeria)

13. Round-leaved bloodwood (*Pterocarpus rotundifolius*, Malawi)

14. Monkey comb (*Amphilophium crucigerum*, Panama)

15. Monkey ears (*Enterolobium cyclocarpum*, Honduras)

16. Kapok (*Ceiba pentandra*, Ghana)

17. Giraffe thorn (*Vachellia erioloba*, Zambia)

18. Apple-ring acacia (*Faidherbia albida*, Zimbabwe)

19. Gum arabic acacia (*Vachellia nilotica*, Swaziland)

20. Snuff-box sea bean (*Entada rheedii*, Nigeria)

21. Screw pine (*Panadanus rabaiensis*, Tanzania)

22. (*Isoberlinia species*, West Africa)

23. Coconut (*Cocos nucifera*, Unknown)

24. Pink shower tree (*Cassia grandis*, Unknown)

25. Coco de mer (*Lodoicea maldavica*, Seychelles)

26. Brazil nut (*Bertholletia excels*, Brazil)

27. Devil's claw (*Proboscidea althaeifolia*, North America)

28. Giant banksia (*Banksia grandis*, Western Australia)

29. Prekese (*Tetrapleura tetraptera*, Africa)

30. Carob (*Ceratonia silique*, Mediterranean)

31. Bottle gourds (*Lagenaria siceraria*, Africa)

32. Raphia palms (*Raphia species*, Africa)

33. Sacred lotus (*Nelumbo nucifera*, East Asia)

34. African mahogany (*Afzelia Africana*, West Africa)

FORESTRY AND AGRICULTURE

The Physic Garden was founded on the utilitarian value of plants as medicine. In 1834 Charles Daubeny asserted that botany was more than medicine by renaming the Physic Garden the Botanic Garden. However, the University was reluctant to embrace applied botany, such as forestry and agriculture. Eventually, Daubeny became the first Sibthorpian Professor of Rural Economy (Agriculture), but only in the early twentieth century, with the help of St. John's College, was a Department of Agriculture created. St. John's was also instrumental in establishing forestry, under the leadership of William Schlich. In 1985 the Department of Plant Sciences was created by combining agriculture, botany and forestry. In 2011 the Wood Professor of Forest Science was endowed within the Department of Plant Sciences.

23. Collecting Wood

A xylarium is a specialized collection that contains only one sort of material – wood. The Oxford xylarium was established in 1924, with the foundation of the Imperial Forestry Institute. The collection contains approximately 24,000 hand-sized samples, representing approximately one-fifth of the world's tree species, from nearly 200 different countries. As might be expected, given the collection's origin as an imperial research tool, most of the samples come from economically important timbers of the former British empire.

Selection of wood blocks from the Oxford xylarium (Oxford University Herbaria)

24. Tolkien's Favourite

Black pine (*Pinus nigra*) is an important forestry tree. A specimen in the Botanic Garden, was a favourite of J. R. R. Tolkien. On 26 July 2014, part of the tree split, so it had to be felled. In the absence of documentary evidence, a tradition had grown that the pine was planted in 1800, from seed collected by John Sibthorp. Tree-ring dating of the felled tree showed the pine was planted not by Sibthorp but by Charles Daubeny in the mid-1830s, a period of great transformation in the Garden.

Botanical illustration of the Oxford black pine (*Pinus nigra*) by Rosemary Wise, botanical illustrator in the Department of Plant Sciences for over fifty years and co-founder of the Oxford University Botanic Garden and Harcourt Arboretum Florilegium Society, the last watercolour of the tree Uncatalogued (Oxford University Herbaria)

25. Global Forestry

Over nearly one hundred years, forestry research has responded to the changing needs of societies for trees in temperate and tropical regions. With its origins in empire, Oxford forestry established global networks of collaboration where field work, whether through the establishment of plantations or the surveying of natural habitats for trees, became essential elements. Frequently, such investigations led to the discovery of new species. This specimen, called a type, was collected in what is now Tanzania and was used to describe a rare species of ant-acacia.

Isotype of *Acacia burttii* collected in 1933 in Tanganyika Territory
Burtt 4501 (Oxford University Herbaria)

26. The Case for Forestry

In 1934 the University allocated a site on South Parks Road for a botany and forestry building. Opposition within the University was fierce. The Vice-Chancellor commented that 'some have thought that Foresters should be kept out of Paradise, as Adam and Eve once were, since Forestry is not one of the prime sciences'. A forestry building was officially opened on 19 October 1950. An appeal for gifts of timber from Commonwealth timber producing countries resulted in a vast collection of rare and beautiful woods used in the building fit out.

Items associated with the opening of the Department of Forestry Building in 1950
Uncatalogued (Oxford University Herbaria)

27. Experimental Agriculture

Charles Daubeny realized facilities were needed to grow short-term collections of plants for experimental purposes. Within months of taking over the Garden in 1834, he had laid out an experimental garden, near the river. Here he conducted agricultural experiments on barley, buckwheat and turnips. By 1850, it was proving too small. Consequently, in 1852, he bought land off the Iffley Road, Oxford, as an experimental plot, which he bequeathed to the University. The site was eventually sold for housing.

Charles Daubeny's 1835 sketch of the layout of the experimental garden he created in the Botanic Garden, which was lost when the glasshouses were built in the early 1850s
MS. Sherard 264 (Sherardian Library of Plant Taxonomy)

28. Webs of life

Traditionally, fungi – which include yeasts, moulds and mushrooms – are studied as part of botany. Today they are recognised as a different kingdom of life. Some fungi cause disease, but in many ecosystems, fungi are essential decomposers, releasing plant nutrients back into the environment. The roots of most plants have intimate associations with fungi, called mycorrhizae, which are essential for plant survival. We are now beginning to learn just how important fungi are for tree and crop diseases, and for the survival of forests and the maintenance of crops through the cycling of nutrients.

Fungal specimens collected by G Herpell from the region of Sankt Goar, Germany in the 1880s
Uncatalogued (Oxford University Herbaria)

Top row, left to right

Fly agaric (*Amanita muscaria*)
False death cap (*Amanita citrina*)
Parasol mushroom (*Macrolepiota procera)*
Honey fungus (*Armillaria mellea*)
Sulphur tuft (*Hypholoma fasciculare*)
Brick tuft (*Hypholoma lateritium*)

2*nd row*, left to right

Rooting shank (*Hymenopellis radicata*)
Verdigris slime-head (*Stropharia aeruginosa)*
Chanterelle (*Cantharellus cibarius*)
Common hedgehog mushroom (*Hydnum repandum*)
Yellow-cracking bolete (*Boletus subtomentosus*)
Larch bolete (*Suillus grevillei*)
Sooty milk-cap (*Lactarius fulginosus*)
Sickener (*Russula emetic*)

3rd row, left to right

Velvet-shank (*Flammulina velutipes*)
Russet tough-shank (*Gymnopus dryophilus)*
Woolly milk-cap (*Lactarius torminosus*)
Stinking russule (*Russula foetens*)
Common morel (*Morchella esculenta*)
Penny bun (*Boletus edulis*)

4th row, left to right

Blusher (*Amanita rubescens*)
Shaggy scale-head (*Pholiota squarrosa*)
Scaly-tooth (*Sarcodon imbricatum*)
Grisette (*Amanita vaginata*)
Field mushroom (*Agaricus campestris*)

Bottom row, left to right

Mottle-gill (*Panaeolus papilionaceus*)
Lawyer's wig (*Coprinus comatus*)
Bluefoot web-cap (*Cortinarius glaucopus)*
Wood blewit (*Clitocybe nuda*)
Grey-brown funnel-cap (*Clitocybe metachroa)*
Straw mushroom (*Volvariella volvacea*)
(*Marasmius porreus*)
Red-stemmed tough-shank (*Gymnopus erythropus*)

REPRODUCTION

The beauty of flowers has been admired for millennia, whilst floral function was hardly considered until the late seventeenth century in Europe. Today, the idea that flowering plants reproduce sexually, and that insects are involved in moving pollen, is taken for granted. In the eighteenth century, evidence of plant sexual reproduction was sufficiently modern to be outrageous, as the theological and social implications of the idea were debated. Much of the unpicking of the functions of flower parts, together with the mechanism and biological significance of plant sex, took place outside Oxford. As elsewhere in Britain, the implications of sex as a central concept in biology were not accepted in Oxford until after Charles Darwin asserted that 'Nature tells us, in the most emphatic manner, that she abhors perpetual self-fertilisation'.

29. Pollen is male

English physician Nehemiah Grew was fascinated by how plants worked. In *The anatomy of plants* (1682), he stated: 'In discourse hereof with our Learned Savilian [sic] Professor Sir Thomas Millington, he told me, he conceived, That the *Attire* doth serve, as the *Male*, for the *Generation of the Seed*. I immediately reply'd, That I was of the same Opinion'. This is the first association made between pollen and male function in flowers. Millington's, and hence Oxford's, claim of fundamental involvement in the discovery of plant sexuality has been a cause of academic debate ever since.

Pollen grains illustrated in Nehemiah Grew's *The anatomy of plants* (London, 1682)
Sherard 651 (Sherardian Library of Plant Taxonomy)

30. Fairchild's Mule

Among the specimens in Sherard's herbarium is an example of the first artificially created hybrid plant, Fairchild's mule. The mule, a hybrid between a carnation (*Dianthus caryophyllus*) and a sweet william (*Dianthus barbatus*), was made by the nurseryman Thomas Fairchild of Hoxton in about 1717. In Oxford, the significance of this specimen as the earliest man-made hybrid, and what it represented for the understanding of plant species and plant breeding, went unremarked until the late twentieth century.

Fairchild's mule, c. 1717
Sher-0569-50 (Oxford University Herbaria)

31. Flowers and insects

In 1793, detailed examination of flowers led German naturalist and classicist Christian Konrad Sprengel to conclude that flowers are organs for attracting insects; that insect visitors are rewarded with nectar; and that floral structure helps prevent self-fertilization. Such fundamental conclusions were overlooked until Charles Darwin realized this was a means by which plant genes could move through populations. Pollination biology gained scientific respectability, and became incorporated into botanical research in Oxford.

Decorative title page of Christian Sprengel's *Das entdeckte Geheimnis der Natur im Bau und in der Befruchtung der Blumen* (Berlin, 1793)
581 SP1 (Sherardian Library of Plant Taxonomy)

32. Fundamental floral biology

In the last two decades of his life, Charles Darwin wrote a series of books that presented concepts that remain fundamental to our understanding of the biology of flowers. These included *On the various contrivances by which British and foreign orchids are fertilised by insects* (1862) and this volume which provided new insights into how plants cross and self-fertilise.

Charles Darwin's *The effects of cross and self fertilisation in the vegetable kingdom* (1876)
581.16 DAR/BT (Sherardian Library of Plant Taxonomy)

33. The Oxford Hybrid

Oxford ragwort (*Senecio squalidus*), a hybrid between two Sicilian species, probably arose in cultivation in Britain in the early eighteenth century. From Bobart the younger's time until the early 1800s, Oxford ragwort was a novelty confined to the city's walls and a few parishes associated with Oxford-trained clergy. Arrival of the railways in the 1840s saw the plant begin to colonize sites across Britain. Today, university researchers use it as a model plant to study many aspects of plant evolution.

Oxford ragwort from William Baxter's *British Phaenogamous Botany* (Oxford, 1834)
(4.1) BA2Ee (Sherardian Library of Plant Taxonomy)

34. Flower structure

By the end of the nineteenth century, floral structure and function were central to botanical teaching and research. In early twentieth-century Oxford, Arthur Harry Church (1865 – 1937), one of the most original botanical thinkers of his era, began detailed investigations of floral morphology, culminating in this text accompanied by his immaculate botanical illustrations.

Greater snowdrop (*Galanthus elwesii*) from Arthur Church's *Types of floral mechanism: a selection of diagrams and descriptions of common flowers arranged as an introduction to the systematic study of angiosperms* (Oxford, 1908)
581.1 CHU /BT(OS) (Sherardian Library of Plant Taxonomy)

35. Studying Sex

University researchers interested in the evolution of plant sex, study the campion genus, *Silene*. However, its importance in plant science was not immediately recognized. In the late seventeenth century, Bobart the younger had observed that white campion growing wild had flowers that lacked male parts, but never formalized the conclusions. When John Sibthorp explored the eastern Mediterranean in the 1780s, he 'observed upwards of thirty different Sorts', but did not comment that some species have flowers with male and female parts, while others have male and female flowers on separate individuals.

Watercolour of *Silene longipetala*, based on sketches made by Ferdinand Bauer in the eastern Mediterranean in 1786/87, and made in Oxford between 1788 and 1792
MS. Sherard 241 (Sherardian Library of Plant Taxonomy)

36. Models of Diversity

Flowers typically have organs associated with protection, pollinator attraction and male and female function. The diversity of these structures is immense, and botanical models were a practical solution to help students and teachers understand the arrangement of floral structures regardless of season. These robust, hard-wearing models were made by expert artisans using any materials available, including papier-mâché, wood, plaster, gelatin, rattan, wire and gutta-percha, before being painted, varnished and assembled by hand. Collaboration with botanists ensured accuracy and the models were often accompanied by detailed teaching notes. Frequent handling by generations of students means only a fraction of the thousands of models sold before World War Two survive today. Those that do survive are highly collectible.

Late-nineteenth century, mass-produced models made by the Maison Auzoux and the Maison Émile Deyrolle in France, and the Brendel Company in Germany and sold around the world.
Uncatalogued (Oxford University Herbaria)

Saxifrage (*Saxifraga*)

Rue (*Ruta*)

Sallow-wort (*Vincetoxicum*)

Birch (*Betula*)

Fumitory (*Fumaria*)

Willow (*Salix*)

Grape (*Vitis*)

Henbane (*Hyoscyamus*)

Dock (*Rumex*)

Heather (*Ericaceae*)

Milkwort (*Polygala*)

Stinging nettle (*Urtica*)

Autumn crocus (*Colchicum*)

Buckthorn (*Rhamnus*)

Woodruff (*Asperula*)

Goosefoot (*Chenopodium*)

St. John's wort (*Hypericum*)

Spurge (*Euphorbia*)

COLLECTION AND COLLECTORS

Collecting is the earliest stage in the scientific enterprise. Collectors' decisions in the field have repercussions for all subsequent uses made of their work. Botanical exploration is a serendipitous activity, involving plants that attract attention at specific times and in specific places. People collect plants for many different reasons. For some, plants were another spoil of adventure, or a means to personal fame; others wanted to answer specific questions or were inspired by ideas.

Collectors might travel individually, on *ad hoc* expeditions, or on commissioned enterprises which might be financed by personal fortunes, the generosity of philanthropists, or the largesse of governments. Plants may be associated with the names and activities of few individuals, but hundreds of people have silent association with these specimens through their voluntary, paid or coerced labour, or through the local information they provided.

37. Water Lily Craze

Discovery in the nineteenth century of a South American water lily (*Victoria amazonica*), with its huge, floating, dish-like leaves and buds the size of a child's head, led to competition among British gardeners to get it to flower in cultivation. The race was won by Joseph Paxton in 1849, in glasshouses at Chatsworth House, Derbyshire. Charles Daubeny wanted the lily in Oxford, so in 1851 the Lily House tank became the centrepiece of a new glasshouse complex in the Garden.

Specimen of *Victoria amazonica* from Chatsworth House, given by Joseph Paxton
Paxton sn, (Oxford University Herbaria)

38. Collectors in North America

North America offered the prospect of great natural-history riches in the eighteenth century. For British naturalists to benefit, they needed skilled, dedicated and reliable collectors. English naturalist Mark Catesby was such a man. Between 1722 and 1726, Catesby travelled through the Carolinas into Georgia, Florida and the Bahamas sponsored by a group led by William Sherard. He sent hundreds of herbarium specimens back to England, where the majority are now found in Oxford University Herbaria.

American lotus (*Nelumbo lutea*) leaf collected by Mark Catesby, Carolina, 1720s
Sher-1090 (Oxford University Herbaria)

39. Drawn in the Field

Mark Catesby was a self-taught artist and when specimens proved a challenge to preserve, he drew them. A pen-and-ink drawing of the American lotus flower (*Nelumbo lutea*) was sent to William Sherard, along with the note 'The flowr I could not preserve so have sent this scetch'. In the early nineteenth century, German-American botanist Friedrich Traugott Pursh was delighted to discover Catesby's specimens in Oxford as he worked on one of the earliest Floras of North America.

Field sketch of American lotus (*Nelumbo lutea*) made by Mark Catesby
Sher-1090a, (Oxford University Herbaria)

40. A Conversation in the Margins

Herbarium specimens are frequently annotated. The added notes accumulate and preserve the opinions and conversations between scholars. This annotated specimen of white waterlily (*Nymphaea alba*), which Johann Dillenius used when he revised Ray's *Synopsis methodica stirpium britannicarum* (1724), records comments from Peter Collinson in 1739. Dillenius's work was Carl Linnaeus's primary source of information on the British flora. In the early twentieth century, George Druce here added the plant's binomial name.

Specimen of *Nymphaea alba*, probably collected by or given to Johann Dillenius
Syn-368.3 (Oxford University Herbaria)

41. Sibthorp's Field Guide

John Sibthorp conceived his idea of exploring the eastern Mediterranean as he studied in Vienna, one of the great centres of European botany. Here he studied the Western world's oldest botanical manuscript, an early sixth-century Byzantine copy of Dioscorides' *De materia medica*. He also encountered the exceptional artist, Ferdinand Bauer. When he left Vienna in 1786 to begin his exploration with Bauer, Sibthorp also had in his possession this book, one of the few printed copies of the illustrations from the *De materia medica* - it became his field guide to the medicinal uses of plants.

Water lily from Sibthorp's printed copy of the *Codex Vindobonensis*
Sherard 443 (Sherardian Library of Plant Taxonomy).

42. Sibthorp's Diary

John Sibthorp, the third Sherardian Professor of Botany, led, inspired and funded two famous journeys (1786–87 and 1794–95) that explored the natural history of the eastern Mediterranean. Sibthorp made his ambitions clear: 'I form my greatest Expectations from whence I hope will flow a future Source of Fame … Many Discoveries are still to be made for the Natural History of these Countries if not imperfectly known. … The Superiority of my Draughtsman … will entitle me to a Place in the Petersburg or in our Academy with just Pretensions'.

John Sibthorp's manuscript diary of his exploration of the eastern Mediterranean in 1786/87
MS. Sherard 215 (Sherardian Library of Plant Taxonomy)

43. Named and Re-named

In his original field notes, John Sibthorp named this plant '*Fritillaria Emereii*', after Ninian Imrie, a British military engineer and likely spy. At the end of March 1787, Sibthorp's party landed at Porto Cavaleri (near Akyar Burnu, Turkey). Imrie 'who was by far the most agile of our party after much labour and difficulty reached the summit of the nearest mountain & brought back with him a new and elegant species of *Fritillaria*'. When James Edward Smith, founder of the Linnean Society of London, wrote up Sibthorp's work he renamed the plant in Sibthorp's honour.

Specimen of *Fritillaria sibthorpiana* (type of *Tulipa sibthorpiana*) collected by Imrie on the mainland opposite Rhodes in 1787
Sib-0790 (Oxford University Herbaria)

44. Sketched in the Field

During their expedition, Sibthorp collected all manner of natural-history and archaeological objects. As a travelling artist, it was Ferdinand Bauer's task to record accurately plants and animals, often working quickly under harsh conditions. It was therefore necessary for Bauer to devise means to minimize the amount of drawing materials he carried. Bauer's strategy was to make only pencil sketches in the field, on locally acquired paper, and to surround each sketch with numbers that corresponded to a colour code of his own devising, such as here with Imrie's fritillary.

Field sketch of *Fritillaria sibthorpiana* made by Ferdinand Bauer in 1787
MS. Sherard 247(6), (Sherardian Library of Plant Taxonomy)

45. Drawn in Oxford

Returning to Oxford in 1788, Ferdinand Bauer who 'joins to the Taste of the Painter, the Knowledge of a Naturalist' used his field sketches to produce 966 finished botanical watercolours. Bauer's work is characterized by his attention to detail, the speed at which he worked (each watercolour was completed in about 1¼ days) and his memory for colour. Until it was rediscovered by two Scandinavian botanists in 1972, *Fritillaria sibthorpiana* was known only from the few specimens collected by Ninian Imrie, Bauer's field sketches and this watercolour.

Watercolour of *Fritillaria sibthorpiana* by Ferdinand Bauer based on his field sketch
MS. Sherard 245 (Sherardian Library of Plant Taxonomy)

46. Printed – No Expense Spared

On his death in 1796, John Sibthorp left provision to complete the publication of the ten-volume Flora Graeca (1806–1840), based on Bauer's botanical watercolours. Outside Oxford, the process of publication was tortuous and the costs vast (£254 per copy), but eventually 25 copies appeared. Today, the *Flora* is known for the extravagance of its publication and the magnificence of its hand-coloured plates: the botanist was eclipsed by the artist.

Salvia veneris, a sage found in Cyprus, from the first volume of Sibthorp and Smith's *Flora Graeca* (London, 1806)
Sherard 761 (Sherardian Library of Plant Taxonomy)

47. An Experimental Wood

Wytham Woods, an ancient semi-natural woodland to the north west of Oxford, has been owned and maintained by the University since 1942. Baseline botanical data on the woods were collected by zoologist and ecologist Charles Elton in the 1950s. In the early 1970s, Colyear Dawkins, a lecturer in the Department of Forestry, systematically laid out permanent sample plots across the Woods. The idea was to use the Woods as a living collection so that long-term changes could be investigated. Over almost five decades, data from these plots have been recorded, providing detailed insights into changes in forest landscapes.

Specimen of herb-paris (*Paris quadrifolia*), Wytham Wood, 9 May 1953
Elton_100.18.1 (Oxford University Herbaria)

48. Collecting the Plants of Britain and Ireland

George Claridge Druce was a self-made, idiosyncratic, botanical autodidact. He built his reputation as the leading authority on British and Irish flora in the early twentieth century, amassing hundreds of thousands of specimens to form his personal herbarium. In 1895, he was made honorary curator of the University's herbarium, and spent the rest of his life giving it the attention it had lacked for decades. Druce bequeathed his herbarium and the bulk of his substantial fortune to the University.

Herbarium specimens of spring gentian (*Gentiana verna*) collected by George Claridge Druce at various localities in County Clare, Ireland, in the early twentieth century
Druce sn. (Oxford University Herbaria)

49. Plant Collecting Kit

Making high-quality specimens, which remain scientifically useful over centuries, is a skilled process. Here is a typical plant collecting kit from Britain belonging to George Druce (1850–1932). It includes a vasculum (container), together with his knife, hand lens, notebook and maps. Whilst the fundamental technologies of drying plants under pressure have changed little over centuries, modern collectors use all the technology available to make detailed notes about where plants grow, their appearances and ecology.

George Claridge Druce's plant collecting kit, early twentieth century
Uncatalogued (Oxford University Herbaria)

50. A Pirate and a Botanist

English 'privateer-naturalist' William Dampier circumnavigated the world between 1699 and 1701, sponsored by the British government. Among the many natural-history observations he made, he collected some of the first herbarium specimens from Australia and Brazil. Dampier's specimens were eventually given to William Sherard, who bequeathed them to the University in 1728. However, interest in Dampier's collections declined during the century, leaving their significance overlooked until the late twentieth century.

A Brazilian nightshade, *Solanum paniculatum L.* (Solanaceae). Epitype of *Solanum brasilianum* Dunal, collected by William Dampier around Salvador, Brazil, in March/ April 1699
Sher-0451-a (Oxford University Herbaria)

51. Botanical Blunder

In Leonard Plukenet's *Amaltheum botanicum* (1705), a plant with three leaves, a handful of flowers and prickly stem is illustrated. It was drawn from the specimen of William Dampier's Brazilian nightshade. In 1813, Michel Dunal used this image to describe a new, very rare nightshade species. However, Dunal never bothered to search for the model, which was rediscovered in Oxford in the 2010s. Comparing specimen and illustration showed the illustrator had mistaken a bud for a prickle; Dunal's species was neither new nor rare. Dunal had described his species assuming the illustrator's work was accurate.

Solanum paniculatum L. (Solanaceae). Lectotype of *Solanum brasilianum* Dunal, from Leonard Plukenet's *Amaltheum botanicum* (London, 1705)
Sherard 567 (Sherardian Library of Plant Taxonomy)

52. Modern Field Work

Plant collecting and species discovery are still crucially important today. Collectors explore geographical areas, expanding our knowledge of species' distribution and discovering new plant species. Modern monographic work by Oxford-based researchers synthesize centuries of historic and modern plant collecting, with DNA analyses, to catalogue and classify plant diversity. Here they seek to understand the evolution of the sweet potato family.

Type specimen of *Ipomoea longibarbis*, collected in Bolivia by John Wood, Daniel Villaroel and Beth Williams in 2013, and formally described as a new species by John Wood and Robert Scotland two years later
Wood 27633, OXF_00005953M (Oxford University Herbaria).

TEACHING

In the late eighteenth century, John Sibthorp recognised the connections between gardens and wellbeing. He claimed that teaching a student botany in the Garden would 're-establish his Health deranged by the Confinement of the Closet'. He was not alone in believing a botanical education had benefits beyond a knowledge of plants. However, the interest shown by professors of botany in teaching, since the first lecture was given in 1670, had been sporadic. Two teaching highpoints were Sibthorp's taxonomic lecture course in the late 1780s and Charles Daubeny's physiological and agricultural lectures in the mid nineteenth century. Today, plant scientists working in Oxford spread information to audiences across the world, using a broad range of media. Their messages are clear: plants are important in our lives, and worthy of sustained curiosity by excellent researchers and teachers.

53. Light teaching Duties

In 1736, teaching duties of the Sherardian Professor of Botany were formalized. He was to: 'begin his Lectures about ye middle of March … & twice in ye Week during ye Months May, June, July & August, unless he shall think fit to absent himself on his own or Garden-Affairs … The Length of ye Lecture to be calculated in Proportion to ye Number of Plants growing in the Garden'. For the next 200 years, these rules were sometimes followed, but perhaps more often broken.

Rules associated with the teaching to be undertaken by the Sherardian Professor of Botany, 7 February 1735 corrected to 1736
MS. Sherard 1 (Sherardian Library of Plant Taxonomy)

54. Plant Science in Difficulty

In 1888 Sydney Vines, having transformed botanical teaching at the University of Cambridge, arrived in Oxford as the eighth Sherardian professor. The Oxford botany department might have been the most venerable in the country, but it had just two research laboratories at the Botanic Gardens dating from 1870s. Vines soon lost his fire as he battled with University authorities for adequate teaching space. By the end of the century, he eventually secured additional facilities, but they still compared poorly to those in other British institutions.

By the 1920s, research space was again critical. A lecture theatre at the Garden was leased from Magdalen College and this room became Botany's main research laboratory until the Department moved to the Science Area in 1951.

These photographs show the cramped working conditions at the Botanic Gardens in the 1930s.
Uncatalogued, (Oxford University Herbaria)

55. Outgrowing the Garden

The success of twentieth-century botanical teaching and research required the Department of Botany to vacate the cramped, dysfunctional conditions at the Botanic Garden. Consequently, in the 1930s a decision was taken to move the Botany Department to a purpose-built facility, adjacent to the Department of Forestry, on the Science Area in South Parks Road. War intervened, and it would take another fifteen years before the Department officially moved on 8 October 1951. Back at the Garden work now focused on horticulture and recreation.

Items associated with the opening of the Department of Botany Building in 1951
Uncatalogued, (Oxford University Herbaria)

56. Sibthorp's Lectures

In the late 1780s John Sibthorp introduced an annual 30-lecture Linnaean botany course, delivered to an audience of young men interested primarily in medicine and agriculture. The course was based in the Garden, where virtually no teaching had taken place for over 50 years. It drew on Sibthorp's field work, the University's living and preserved collections, its botanical library, and the wealth of botanical watercolours being made for Sibthorp by Ferdinand Bauer.

Lecture notes John Sibthorp gave to students between 1788 and 1793
MS. Sherard 219 (Sherardian Library)

57. The Importance of Science

Charles Daubeny argued science was complementary to literary and classical studies in the University. He was concerned that teaching of the natural sciences in nineteenth-century Oxford did not match the standards in other parts of Britain and Europe. As early as 1822, against prevailing opinion, he argued that the natural sciences should be part of elementary liberal education for all undergraduate students. Holding both the Sherardian and Sibthorpian professorships, he became a popular teacher of botany and scientific agriculture.

Charles Daubeny's notes for a lecture on the history of agriculture
MS. Sherard 373 (Sherardian Library of Plant Taxonomy)

58. First Female Students

In his lectures, Charles Daubeny focused attention on plant function and the application of botanical knowledge. When his predecessors taught, they were concerned with plant names, classification and catalogues of plant forms. Lists of lecture attendance show that few students elected to study botany. The first women, Miss Straub and Miss Jackson, are recorded as attending, although not as matriculated students, a course in 1866. Even by 1920, when women could formally matriculate, they were rarely taken as students in botany.

Attendance register of an 1866 botanical lecture course
Uncatalogued (Oxford University Herbaria)

59. Engaging Students

Arthur Harry Church took over teaching in 1894 as Sydney Vines' demonstrator. Over the next fifteen years, lectures, practical classes and tutorials – became his *de facto* responsibilities. As a charismatic teacher, Church learned from his own poor experiences as a student, producing lectures designed to stimulate the intellect but also to entertain. He also made his own botanical illustrations for both his teaching and his research.

Diagram of the magnified male flower of common oak (*Quercus robur*) made by Arthur Harry Church, dated 1911
MS. Sherard 406 (Sherardian Library of Plant Taxonomy)

60. New Beginnings

When Arthur Tansley became tenth Sherardian professor in 1927, he was the foremost plant-ecology researcher in Britain. He was also a popular and effective teacher of botany. Despite finding Oxford a difficult place in which to do innovative work, he transformed botanical teaching in the University. New, talented staff with progressive ideas helped increase the numbers of students. The range of subjects broadened from systematics and physiology to include genetics, mycology and ecology.

Undergraduate lecture timetables for 1933–35
Uncatalogued (Oxford University Herbaria)

61. Living Collections

Living plants, studied in the field or Garden, have been essential for botanical training at Oxford since Robert Morison's first lecture at the centre of the Physic Garden in 1670. The Garden's plants have reflected changing teaching interests, whether as collections of medicinal plants, or plantings to reflect prevalent plant classification systems. The current Garden's spurge (*Euphorbia*) and waterlily (*Nymphaeaceae*) collections have their origins in the botanical research and teaching needs of the twentieth century.

Watercolour of *Euphorbia x pasturii* by Penny Gould, a member of the Oxford University Botanic Garden and Harcourt Arboretum Florilegium Society; uncatalogued, (Oxford University Herbaria)
Watercolour of N*ymphaea x daubenyana* by Margaret Fitzpatrick, a member of the Oxford University Botanic Garden and Harcourt Arboretum Florilegium Society; uncatalogued (Oxford University Herbaria)

62. Research Value of Thale Cress

During the last few decades, rapidly growing thale cress (*Arabidopsis thaliana*) has become an easily manipulated, experimental model for investigating the fundamental workings of plants. Most of this knowledge has come from pure research, conducted because researchers were curious about how plants work. Fundamental knowledge derived from thale cress has been transferred to practical applications in agriculture and forestry. However, the more we have learnt from thale cress, the more we have come to realize its limitations.

Watercolour of *Arabidopsis thaliana* by Barbara McLean, co-founder of the Oxford University Botanic Garden and Harcourt Arboretum Florilegium Society
Uncatalogued (Oxford University Herbaria)

63. A Botanical Museum

Physical objects, whether as living or preserved plants, botanical illustrations or models, have been used by generations of botany teachers to engage students. In 1859 Charles Daubeny created a botanical museum at the Garden for 'material necessary for showing in lectures'. The collection included a 'large collection of models and specimens (both in spirit and dry)' made by skilled artists and technicians. By 1920 the cost of running the museum proved too much, as teaching priorities had changed; most of the objects are now lost.

Selection of teaching materials used in the late 19th century and early 20th century
Uncatalogued (Oxford University Herbaria)

Why study plant sciences?

Lucy Morley, third year undergraduate

‘I have grown up in one of the most wooded counties in the country. Many plants need our protection, so I was driven into plant research by wanting future young people to be able to grow up enjoying these remarkable environments too.’

Aston Saini, DPhil student

‘Plants are the silent heroes of our planet. They provide food, a healthy atmosphere, and support so much of the life that we cherish and rely on. Being able to understand how plants work, and optimising their greatness to help build a better planet is why I love being a plant scientist.’

Barley Rose Collier Harris, DPhil student

‘I think plants are really cool. There is still so much more to learn about them and I wanted to be a part of that. There can be a huge worldwide impact from the work done in plant sciences, from food security, the environment and renewable fuels, to finding new medicines and protecting heritage.

Flynn Bizzell, Undergraduate

‘Plants provided me an escape when I needed it most. The plant world is so full of mystery, there is still so much we do not know, and it is so easy to let the noise of the digital age dissolve when I’m surrounded by plants.’

Tom Wells, DPhil student

‘Plants have an incredible, almost alien diversity, on which we depend for most aspects of our existence. This combination of the intriguing and the essential is what drew me first to gardening and later to botany and plant systematics, where I now focus on investigating the evolution and contemporary diversity of crops and their wild relatives.’

Andrew Wood, DPhil student

‘I chose to study plant sciences to address the challenges of the future. It’s a really exciting and dynamic research area, and the work is lots of fun!’

64. Teaching Posters

In the Botanic Garden, John Sibthorp illustrated his lectures with engravings from books and original illustrations that he handed around among his students. By the 1870s, lithography meant that large, coloured instructional wallcharts could be produced economically. Such images made it possible to teach students in large lecture rooms, show microscopic detail of plants and produce visual impact. In Oxford, commercial wallcharts from Germany, France and Switzerland were complemented with bespoke charts made by technicians or academics in the University.

Posters showing Polytrichum, a moss; Dryopteris, a fern; and Chara, a stonewort, from Arnold and Carolina Dodel-Port's *Atlas der Botanik*, (Esslingen am Neckar, 1878–1883)
Uncatalogued, (Oxford University Herbaria)

EXPERIMENTAL BOTANY

Botany at Oxford from the seventeenth to the nineteenth centuries was typically concerned with cataloguing and classifying plants. Critical investigation of other aspects of botany such as physiology, reproduction, chemistry, ecology and pathology were happening across Britain and Europe, but did not take hold in Oxford until the 1830s. Today, the technology of molecular biology, together with ready access to computing power and near-instantaneous communication across the globe, has dramatically altered the way in which plant sciences are done in Oxford, as elsewhere. Research is rarely undertaken by a single scholar; academics are surrounded by a team of research students and postdoctoral research assistants, and often work with colleagues across the world. Consequently, the questions asked, the hypotheses tested and the answers generated are the products of collaboration.

65. Towards Experimentation

In the eighteenth century, Oxford botanists concentrated their research on the description and cataloguing of global plant diversity. They generally ignored results from botanical experiments such as those of Teddington-based clergyman Stephen Hales. He investigated the problem of sap movement through plants, and the practical benefits it could bring to agriculture. His experiments, together with close, logical reasoning and detailed presentation of data, set the bar for conducting plant physiology experiments and reporting results.

Demonstration of the movement of water from the roots to the shoots in Stephen Hales' *Vegetable Staticks* (London, 1727)
Sherard 472 (Sherardian Library of Plant Taxonomy)

66. Anatomizing Wood

The wood collection built by the Department of Forestry was the primary research tool of wood anatomist Leonard Chalk. During the 1930s Chalk and his colleague Mary Chattaway, together with Samuel Record at Yale, and Bernard Rendle, laid the foundations for modern wood anatomy. They produced practical tools enabling wood samples to be accurately identified using the microscope.

Collection of wood blocks and a manual multiaccess key used to identify wood based on anatomical features
Uncatalogued (Oxford University Herbaria)

67. Microscopic worlds

From the mid-nineteenth century, advances in optics and industrial manufacture ensured high-quality research microscopes became readily available. Moreover, researchers developed new methods, e.g, cutting and mounting very thin sections and tissue-specific stains, that enabled them to explore the details of the internal structure of plants.

Uncatalogued (Oxford University Herbaria)

68. Experimental Research

At Oxford University in the 1920s, the plant scientists George and Mary Snow converted part of their home to conduct fundamental experimental research, using surgical techniques, on how plants respond to external stimuli. The 1950s saw Lionel Clowes discover cells in plant root tips that were apparently inactive (quiescent centre). The ideas spawned by the Snows and Clowes, which derived from rigorous experimentation from the 1920s into the 1970s, are now fundamental to plant developmental research.

Notebooks and slides of Lionel Clowes' research
Uncatalogued (Oxford University Herbaria)

69. Knowledge and Luck

Serendipity and the prepared mind are important elements of research. Scientific fashions change. Without careful preservation, the raw materials of research may disappear. As new technologies emerge, collections are used in new ways to yield new botanical insights. The only known, actively-growing, fossilized root tip was discovered in a 320-million-year-old fossil in a collection that had been ignored for almost a century and was earmarked for disposal. This fossil now provides fundamental insights into root development and evolution.

Radix carbonica, thin section made from sample collected from the Lancashire and Yorkshire coal field, holotype, late 19th century
Foss-Slide_081 (Oxford University Herbaria)

70. Living and non-living interactions

Researchers in the Department of Botany in Oxford started serious investigation into the plant ecology of woodlands, grassland and freshwater habitats after Arthur Tansley became Sherardian professor in 1927. Tansley introduced the ecosystem concept into ecology in the early 1930s, although the actual word was the invention of a young member of his staff, Arthur Clapham. Today, much ecological research focuses on how plants can alleviate the problems associated with environmental change.

Lantern slides of habitats around Oxford, Arthur Harry Church, early twentieth century
Uncatalogued (Oxford University Herbaria)

PROFESSORIAL TIMELINE

1621 Oxford Botanic Garden founded

1669 Robert Morison (1620–1683) appointed as Danby and Regius professor

1720 Edwin Sandys appointed as professor of botany

1724 Gilbert Trowe (d.1734) appointed as professor of botany

1734 Johann Jacob Dillenius (1684–1747) appointed as first Sherardian professor

1747 Humphrey Sibthorp (c.1713–1797) appointed as second Sherardian professor

1784 John Sibthorp (1758–1796) appointed as third Sherardian professor

1796 George Williams (c.1762–1834) appointed as fourth Sherardian and Regius professor

1834 Charles Giles Bridle Daubeny (1795–1867) appointed as fifth Sherardian professor

1840 Charles Giles Bridle Daubeny (1795–1867) appointed as Sibthorpian professor

1868 Marmaduke Alexander Lawson (1840–1896) appointed as sixth Sherardian professor and Sibthorpian professor

1884 Isaac Bayley Balfour (1853–1922) appointed as seventh Sherardian professor

Joseph Henry Gilbert (1817–1901) appointed as Sibthorpian professor (until 1890)

1888 Sydney Howard Vines (1849–1934) appointed as eighth Sherardian professor

1894 Robert Warington (1838–1907) appointed as Sibthorpian professor (until 1897)

1906 William Somerville (1860–1932) appointed as Sibthorpian professor

1920 Frederick William Keeble (1870–1952) appointed as ninth Sherardian professor

1925 James Anderson Scott Watson (1889–1966) appointed as Sibthorpian professor

1927 Arthur George Tansley (1871–1955) appointed as tenth Sherardian professor

1937 Theodore George Bentley Osborn (1887–1973) appointed as eleventh Sherardian professor

1945 Geoffrey Emett Blackman (1903–1980) appointed as Sibthorpian professor

1953 Cyril Dean Darlington (1903–1981) appointed as twelfth Sherardian professor

1970 John Harrison Burnett (1922–2007) appointed as Sibthorpian professor

1971 Robert Whatley (1924–2020) appointed as thirteenth Sherardian professor

1980 David Smith (1930–2018) appointed as Sibthorpian professor

1990 Christopher John Leaver appointed as Sibthorpian professor

1991 Hugh Dickinson appointed as fourteenth Sherardian professor

2007 Nicolas Harbard appointed as Sibthorpian professor

2009 Liam Dolan appointed as fifteenth Sherardian professor

2013 John Mackay appointed as Wood professor of Forest Science

PORTRAITS

Johann Dillenius (1687–1747)

Johann Dillenius practised medicine in Germany until he moved to England in 1721 to help William Sherard compile his herbarium and *Pinax*. Dillenius became the first Sherardian Professor of Botany in 1734. He cared little for the pretensions and trappings associated with his position at Oxford, and he was the first, and last, Sherardian Professor to publish significant taxonomic research while in post. During his lifetime, Dillenius was honoured by Carl Linnaeus in the name of the elephant-tree genus *Dillenia*, which has 'the showiest flower and fruit, so Dillenius among botanists'.

Portrait of Johann Jakob Dillenius holding a coloured drawing of the Jacobaean lily (*Sprekelia formosissima*), unknown artist
LP 247

Charles Daubeny (1795–1867)

Charles Daubeny was a chemist, geologist and botanist, who carried out research at the interface of these three disciplines. It was his reputation which briefly turned the Garden into a respectable place to conduct botanical research. In 1834 he was elected the fifth Sherardian Professor of Botany, and set about transforming the Botanic Garden largely at his own expense. In 1840 he became the first holder of the Sibthorpian Chair of Rural Economy. He is commemorated in the South African genus *Daubenya* of bulbous flowering plants.

Portrait of Charles Daubeny, unknown artist, mid-nineteenth century
(Department of Plant Sciences)

Robert Morison (1620–1683)

Aberdeen-born Robert Morison fought the Royalist cause, then escaped to France where he met Charles II. In 1669, Morison was elected Regius Professor of Botany at the University, the first such position in Britain. He gave his first lecture in September 1670, but one commentator thought his words 'much spoyled by his Scottish tone'. Killed in a road accident, Morison was not replaced as professor for over fifty years. Morison is commemorated in the name *Morisonia*, a group of Caribbean capers.

Portrait of Robert Morison, probably by William Sunman (Sonmans; d.1708) (Department of Plant Sciences)

William Sherard (1659–1728)

William Sherard was one of the architects of early eighteenth-century European botany. He identified and nurtured botanical talent, maintained academic networks and built one of the world's largest pre-Linnaean herbaria. As a law student at St. John's College, Sherard began a lifelong friendship with Jacob Bobart the younger. The final years of his life were absorbed by his *Pinax* (see item 9). He bequeathed his wealth and herbarium to the University, creating the Sherardian Chair of Botany and forcing the University to provide regular funding to the Physic Garden. Linnaeus named the Eurasian field-madder genus *Sherardia* in Sherard's honour.

Portrait of William Sherard, unknown artist, early eighteenth century (Department of Plant Sciences)

A MATTER OF JUSTICE

Throughout this exhibition you will see specimens gathered from across the planet for research and teaching. Each specimen is unique, having an individual history that starts with its collection in the field and continues through to its present-day uses. Many people, and their knowledge, are involved in these histories, but most remain unacknowledged or even marginalised. These include people who help plant collectors in the field by locating plants or by providing knowledge about uses and biology. Once collected, specimens or associated data may be exploited for personal gain, while the people in whose countries these plants were collected never benefit directly.

71. Collected in Brazil

In August 1836, Charles Darwin left Brazilian shores bluntly stating: 'I thank God, I shall never again visit a slave-country'. George Gardner, a twenty-six-year-old, newly qualified Scottish surgeon, had arrived less than a month earlier. Over the next five years Gardner would travel thousands of miles through the Brazilian interior on foot, by horse and by water, collecting tens of thousands of living and dried plants.During these travels Gardner visited ranches which used slave labour. There he acquired knowledge about the uses of the plants from the people he encountered, and was helped in the field by unnamed Brazilians. His specimens remain fundamental to our knowledge of Brazilian plants. This specimen was collected on the ranch of Antonio Jozé de Guimerãens in Tocantins, Brazil, in September 1839, from one of the 'finest trees' Gardner had ever seen in flower. The actual tree was chopped down, but the type was named in his honour.

Like many collectors of the period, Gardner funded his activities by selling specimens to collectors across Europe. This specimen is part of the herbarium of Henry Borron Fielding, who spent his personal fortune building one of the finest private herbaria in nineteenth-century Europe. Fielding's wife, the noteable botanical illustrator Mary Fielding, gave the herbarium to the University in 1853.

Qualea gardneriana Warm. (Vochysiaceae).
Gardner 2841, OXF_00085022, Oxford University Herbaria

72. Collected in North Africa

In 1720 Oxford-trained Thomas Shaw arrived in Algiers as chaplain to a trading company. Shaw's light professional duties gave him the opportunities to explore North Africa and the eastern Mediterranean pursuing his primary interests in geography, antiquities and local customs. In a published account of his explorations Shaw describes being aided by other British trading companies as he benefited from their horses, their servants, local knowledge and, without commenting on it, their slaves. This specimen is one of more than 600 plant specimens he returned to Oxford. Shaw believed that nearly a quarter of these specimens were new species, but gave little detail on how or where they were collected.

Specimen of Magydaris pastinacea, a perennial herb
collected by Thomas Shaw in North Africa in the 1720s
Shaw-417, Oxford University Herbaria

SUPPORTING DECOLONIZATION

Modern collectors work within frameworks of international agreements, such as the Convention on Biological Diversity and the Nagoya Protocol, and under national laws that protect both biological diversity and people's knowledge about the plants around them. However, botanical collections cannot be disassociated from centuries of inequality created by the manners in which they have been constructed. As with other privileged botanical collections, Oxford University Herbaria is grappling with issues associated with the legacies of colonialism. Details of these broader issues can be found at **https://oxfordandcolonialism.web.ox.ac.uk/mathematics-physical-and-life-sciences**

More equal ways of working are being developed. Details of a project aimed at diversifying the Science, Technology, Engineering, and Mathematics (STEM) curriculum, together with the Herbaria's role, can be found at **https://www.mpls. ox.ac.uk/equality-and-diversity/diversifying-stem-curriculum**.

Plant Science – the next 400 years

Plant science has never been more important. Scientists need to work together to tackle global challenges including feeding a growing population, combating crop diseases, and more broadly, living sustainably on our planet. So what do plant scientists of the future think about the future of plant sciences? In five short films, students from the University of Oxford's Department of Plant Sciences share their thoughts on five areas of current research: food security, plant diseases, the roles of forests, plants in space and green cities.

Foods of the Future (3 mins)

Maths against Plant Disease (3 mins)

The Importance of Forests (4 mins)

Plants in Space (2mins 30 secs)

Green Cities (2 mins)

Plant Science – the next 400 years

In the main gallery we explore the first four hundred years of plant science in Oxford. But what about the next four hundred? Plant science has never been more important. We need to work together to tackle global challenges including feeding a growing population, combating crop diseases, and living sustainably on our planet. Find out what plant scientists of the future – students from the University of Oxford's Department of Plant Sciences think about the next big research questions.

What will we eat in the future?

How do you fight plant disease with maths?

How important are forests?

What will we eat in space?

Why make cities green?