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EXPERIMENTAL GARDENS FROM FRANCIS BACON TO TODAY

PROFESSOR JIM ENDERSBY

This lecture is the first in a series that explores the links between science and utopianism, two subjects that might initially seem like opposites. Utopias are usually associated with impracticality, daydreams, and having your head in the clouds; by contrast, science is the ultimate 'feet on the ground' subject, firmly rooted in facts, evidence and proof. However, these two unlikely companions meet in gardens, particularly botanic gardens, and by exploring those links over the course of the next four lectures, I hope to persuade you that utopianism and science have more in common (and, as a result, are a bit more interesting) than you might imagine.

This first lecture centres on experimental gardens, beginning in the seventeenth century at Oxford, which was Britain's first botanic garden, founded in 1621. It compares the Oxford garden to imaginary, utopian gardens (especially those described in Francis Bacon's *New Atlantis*), and then considers the long-term promise of the experimental or scientific garden, which would eventually lead to today's biotechnologies.

God, King and Vegetables

Oxford was Britain's first botanic garden and was originally known as the Physic (i.e. "medicinal") Garden. As with other the European university botanic gardens (such as Uppsala and Leiden) one of its main purposes was to help educate future doctors by allowing them to identify and name the plants that supplied most of the world's medicines at this time.

Among the learned men to be found walking amid the Oxford Garden's orderly flowerbeds in its early years was Robert Sharrock (1630–1684), who used the gardens to conduct practical experiments, which were intended to test the claims he had read about in earlier gardening books. He published the results of his experiments as *The History of the improvement and propagation of vegetables* (1660).

Sharrock's *History* included many practical details, such as a detailed diagram, showing all the different kinds of grafts that could be used to improve and modify a tree. Other sections discussed watering, shade, overcrowding, pruning, etc. and how to avoid "the annoyances in general incident to Garden Plants". The book also included all kinds of practical homely wisdom ("For Vines, it is a Proverb, make your Vine poor and it will make you rich: The fewer principal Stems are left, the more it bears"). In many ways, it's much like a modern gardening book.

However, as we look more closely, the books contains some unexpected comments. A section headed "Of the annoyances in general incident to Garden Plants", begins: "The Politician speaks it to be part of as great skill and prowess to defend a place already gotten, and to improve it to the benefit of the Prince and Inhabitants, as it was at the first to arrive at the Conquest". This language of conquest and colonisation seems very out of place in a gardening book (but, as we shall see in later lectures, is in fact common whenever the 'improvement' of nature is being discussed). Sharrock explained his political comments through an analogy: what was true of the kingdom was "alike true in the Gardiners [sic] Province". And he went on to explain that "It is no easie thing with him [the gardener] to raise a stock of choice Plants, by the several ways of propagation above mentioned, and as hard to preserve them, being propagated, from destruction by foreign and intestine [internal] violence", because of the cold, "the torridness of the Sun, Vermine, or other accident from without". The gardener is the king of his garden and, like the actual monarch, is responsible for the safety and health of his subjects – the plants.

The reference to "intestine violence" is, of course, a reminder that the book was published in the same year (1660) in which Charles II was restored to the English throne, ending decades of Civil War and internal violence. This was one of several analogies Sharrock and his contemporaries between the macrocosm (in this case the kingdom) and the microcosm (the garden); these links reinforced the idea that there was a natural order to the universe, that could not (or should not) be disturbed.

Sharrock was a Church of England clergyman and natural historian. Given his vocation, it is not surprising that he concluded his book "with one or two choice observations of the wise and good Providence of God". The humblest plant, he argued, demonstrated God's wisdom and benevolence; both were apparent "in the admirable make [design] of Vegetables, and fitness to their ends". It was, he argued, "the sin of the Heathen that they did not rise in their mindes from the contemplation of the beauty of the creatures, to consider how such lineaments [characteristics.] could be made". If they had done so, they too would have learned "to glorifie thereby the wisdome of the Maker".

To prove God's providence at work in nature, Sharrock gave examples. "Why", he asked "is the ground in Woods covered with Mosse, but that Nature intended it as a preservation to seeds fallen upon the Turfe in the violence of Winter Frosts?". Sharrock doubtless intended to echo Christ's words (Luke 12:27), when he told his disciples to "Consider the lilies", although "they neither toil nor spin", their 'clothing' was more beautiful than Solomon's; "If then God so clothes the grass", Christ asked, "how much more will He clothe you, O you of little faith?". God's care for the lowest part of creation, the plants, is clear evidence of his benevolence – the soft moss cushions the falling seeds from harm.

Sharrock's writing identifies him as an exponent of the English tradition known as 'natural theology", the claim that – because God made all of nature – by studying the natural world we were studying God, and coming to know him better. Sharrock's close contemporary, John Ray (1627–1705), is often considered the founder of this tradition of natural theology. Nature not only revealed God's existence, but demonstrated his wisdom, foresight and – above all – benevolence, which proved that he really was the God of Christianity. Ray's most important *The Wisdom of God Manifested in the Works of the Creation* (1691), was based on sermons he preached at Cambridge in the 1660s – at exactly the time Sharrock was writing his book.

The historian Anna Svensson has noted that Sharrock drew on Ray's work to argue against the ancient philosophical school, the Epicureans, who asserted that nature emerged from chaos by chance. The Elizabethan gardener and diarist, John Evelyn (another early fellow of the Royal Society), also agreed with Ray and Sharrock that there was too much order in nature for it to be explicable by chance. Hence it must all have been planned and designed by God. We see this kind of thinking reflected in Sharrock's book, in which he claimed that "It is no unusual Theme to treat of the admirable handsomenesse and beauty of the composure of divers vegetables". He assured readers that doing so would prove to them "that every plant shall seem to have more of Mathematicall art, than the knot wherein it is set". He analysed the mathematical precision of plants and the laws that he believed governed their growth, while the "knot" referred to the formal, geometrical pattern of Jacobean gardens. Many gardening books from this period, including John Parkinson's *Paradisi in Sole Paradisus Terrestris (Park-in-Sun's Terrestrial Paradise, 1629)* and Thomas Hill's *The Gardener's Labyrinth* (1594) included images of knots. And the historian Martin Hoyles has noted that Elizabethan and Jacobean gardens were designed as an oasis from which chaos (nature) had been excluded and mathematical order reigned instead. Svensson argues that the "precisely planned and neatly trimmed parterres and topiary within the garden walls" at Oxford echoed the much grander gardens such as those at Het Loo (the Dutch palace owned by the future king of England, William of Orange). Such gardens, she argues "were employed as expressions of legitimate or natural rule".

The rigid, formal geometry of the Oxford Garden reflected the harmonious relationship between god, king and nature; the neat flowerbeds embodied the idea of a natural order, created by God: the king was God's appointed representative on Earth, just as the gardener was king of his garden; so each level was a microcosm of the one above it (another use of macrocosm/microcosm analogies).

The historian Agnes Arber noted that the concept of 'natural law' was widely accepted in the seventeenth century, and referred to the divinely ordained regularities that bound the human and natural worlds. So, 'natural justice' is as much a part of Sharrock's view as 'natural law' applying to the growth and development of plants. He wrote

several books on law which reflect many of the same ideas as his gardening books; what was natural, was good (because God had ordained it).

"A multitude of monstrous untruths"

Sharrock explained in his book that before writing it, he "gave myself the trouble to run over with my eye, all Books I could procure on these subjects". And in doing so, he became convinced that many earlier gardening books contained "a multitude of monstrous untruths, and prodigies of lies, in both Latine and English old and new Writers, worse in their kind then [*sic*] the stories in Sir John Mandevel's [sic] Travels,…" (Sir John Mandeville was supposedly the author of *The Travels of Sir John Mandeville*, a mid-fourteenth-century travel memoir full of marvellous but frankly unbelievable stories.) In Sharrock's opinion, earlier gardening books could not be: "more ridiculously removed not onely from truth, but from any semblance thereof", because earlier scholars had relied almost entirely on *written* sources, which led them to simply repeat fanciful or implausible claims without testing them. It was clearly time for a new approach to gaining knowledge.

These strongly worded attacks on earlier writers might have lead readers to wonder why they should trust Sharrock's book, given that so many others were so unreliable. Sharrock's answer is implied on the book's title page, where he claimed that it had been "Written according to OBSERVATIONS made from Experience and Practice". As he explained inside the book: "I have tryed divers of the Experiments proposed", for example, he had tested the claim that early germination could be procured if the gardener were to soaking the seeds in milk or "strong Muck water". Having done so, he was able to give "the Reader this fruit of my pains, that without any further tryal, he may from my experience be ascertained, that the advantage in acceleration is exceeding inconsiderable by any of these means". In other words, these methods did not work.

The idea of conducting experiments and testing claims for yourself is obvious to us now, but was a revolutionary new idea in seventeenth-century England. Sharrock was a close friend of Oxford men like Robert Boyle (1627–1691) who was fast becoming one of Britain's leading natural philosophers (the name then used for the men – and they were all male at this time – who studied nature; the term "scientist" was coined in the nineteenth century but didn't come into regular use in Britain until the twentieth century).

Sharrock dedicated his book to his friend Boyle, who he described as "A most worthy pattern of true Honor and Learned Promoter of true Science". By "true science" Sharrock meant the new 'experimental philosophy' that was exemplified by books like Boyle's *New Experiments Physico-Mechanical, Touching the Spring of the Air, and its Effects* (1660), which gave details of Boyle's celebrated experiments using a vacuum chamber or "air pump". Boyle reflected the scholastic notion that nature could not tolerate a vacuum, he showed how it was perfectly possible to produce one, and this enabled him to illustrate the characteristics and functions of the air. Among the most famous of his experiments was showing that a burning candle went out when the air was withdrawn, and that a living creature would also die, thus establishing the relationship between combustion and respiration that would eventually lead to the discovery of the gas we now call oxygen.

Sharrock was part of a group who met at Boyle's lodgings in Oxford, several of whom would go on to be founding fellows of the Royal Society. They all shared the ideals embodied in Boyle and Sharrock's books: that new knowledge could be discovered and tested by experiments, and these experiments should be conducted in public, where anyone could see them, and then published, so that anyone could read about them. The Royal Society was dedicated to these ideals when it met for the first time on 28 November 1660 at Gresham College, London. Among those present were members of the Royal court, including William Brouncker (a friend of the king's, who had shared his exile in France, and became the Society's first president).

The Royal Society included Robert Hooke, who was appointed Gresham Professor of Geometry in 1665, the year in which he published his revolutionary and best-known work, *Micrographia*, featuring beautiful engravings of the wonderful things he had glimpsed using one of the new microscopes. Hooke claimed that "every considerable improvement of Telescopes or Microscopes" revealed "new Worlds". His metaphor – drawn from the discovery of America – was immediately intelligible and exciting to his audience. The fact that America was not mentioned in the Bible or any of the great classical authorities was hugely important; it suggested that entirely new knowledge

was possible, whereas many Renaissance and Medieval scholars had concentrated on recovering lost knowledge from classical antiquity.

The ideals of the Royal Society were celebrated in Thomas Sprat's *History of the Royal Society* (1667), but as the Society had only been in existence for seven years, there wasn't actually a lot of "history" to recount; Sprat's book is really a manifesto, propagandising on behalf of the Society and its future goals. In its early years, the Society included both Parliamentarians and Royalists, Protestants and Catholics, and one of its goals, according to Thomas Sprat, was to put aside, "the passions, and madness of that dismal Age", so the Society's members avoided political discussion and partisanship of all kinds, while maintaining a public loyalty to the Stuart monarchy.

The frontispiece of the *History* featured a bust of Charles II (rather generously credited with being the Society's "author and patron", even though he took no part in their deliberations and referred to them as "my fools"), flanked by its first president, Brouncker, and the figure of Sir Francis Bacon, who died long before the Society was founded, but whose ideas were its main inspiration.

Bacon was the son of a powerful courtier, but found that opportunities for political advancement were rather scarce by the end of Elizabeth's long reign. He attempted to interest the queen in establishing a major research institute, with a botanic garden, menagerie, library and chemical laboratory, but failed. Nor could he interest James I in the plan, so he took to writing manifestoes in support of his ideas, beginning with the *Advancement of Learning* (1605), which set out many of the basic ideas and claims that were to be most fully developed in the *Novum Organum* ("New Organon") of 1620, which aimed to be a complete revision of Aristotle's logic (known as the organon, i.e. tool or instrument).

Bacon's new philosophy was aimed at generating *new* knowledge, instead of repeating old ideas. He argued that natural philosophy should aim at practical improvements to the human condition (via improved technology, in modern terms) and he argued for the importance of properly organised groups of philosophers and artisans, rather than relying on individuals, however brilliant. New knowledge was his main concern and he was suspicious of appeals to authority, "the discovery of things is to be taken from the light of nature, not recovered from the shadows of antiquity" (*New Organon*, aphorism 122).

The New Atlantis

Bacon's vision was most vividly expressed in his unfinished utopia *The New Atlantis* (published, after his death, in 1627), the last of the long series of books in which he promoted his new, experimental philosophy, whose aim was "the relief of man's estate". Bacon derided scholastic philosophers for conjuring ideas that were both untested and untestable. By contrast, the *New Atlantis* illustrated his vision of what systematic research would look like in practice. He imagined a utopian island where a brotherhood of natural philosophers created new knowledge by conducting experiments, testing their theories against the evidence of their own experience (just as Sharrock and Boyle would do).

Bacon's book is the account of some travellers who a hidden island called Bensalem, which houses a research institution known as Salomon's House. They meet one of the "fathers" who runs it, and he explains it to them: "The end [goal] of our foundation is the knowledge of causes, and secret motions of things; and the enlarging of the bounds of human empire, to the effecting of all things possible". The language of conquest and colonisation is again apparent, and is not coincidental. A key part of Bacon's attempt to persuade monarchs to fund the new philosophy was his claim that "*ipsa scientia potestas est*" ('knowledge itself is power', *Meditationes Sacrae*, 1597), which is usually abbreviated to "*scientia potentia est*" (knowledge is power).

The father of Salomon's House tells the travellers that, among its wonders "We have also large and various orchards, and gardens" in which "we practise likewise all conclusions of grafting, and inoculating, as well of wild trees as fruit trees, which produceth many effects". Sharrock described precisely these procedures in his *History*, one of many connections continuities between Bacon's imaginary vision and the reality that the Royal Society and its allies tried to bring to fruition. And Sharrock mentioned Bacon specifically when he discussed the "Acceleration and Retardation of Plants, in respect to their Germination and maturity".

The gardeners of the *New Atlantis* also claimed that "We make [plants] also by art greater much than their nature; and their fruit greater, and sweeter, and of differing taste, smell, colour and figure, from their nature". These astonishing new plants were central to Bacon's dream of a better world, where hunger – and even death itself – might eventually be conquered. The scientific utopia, of which Bacon's is the first, is built on the idea that nature is in some way defective or deficient, and thus in need of improvement.

The idea that utopia would be a garden was not, of course, invented by Bacon. Many countries and cultures have myths in which paradise was imagined as a garden. However, the Judeo Christian story of the Garden of Eden was the most important point of reference for the Western, Christian tradition that shaped Bacon's *New Atlantis* and its successors. As John Prest has shown, out of such ambiguities, generations of interpreters created various Eden stories, including the idea that the original garden still existed in some hidden corner of the world. These ideas arose in the form of a rich palimpsest in which Christian theology was overlaid on various pre Christian ideas including that of Arcadia (a primitive but unspoiled place), or of a Golden Age (when a benevolent climate ensured that plants bore fruit all the year round without human assistance). But while some dreamed of a lost, effortless garden, others – notably Bacon – imagined that Eden could eventually be regained through hard, human work. As European explorers and travellers discovered more of the world's vegetation, some wondered whether it might, perhaps, be possible to create a garden of all the world's plants, a new paradise on earth.

In the *History*'s second edition (1672), Sharrock wrote: "even in the wayes of Propagation that are most artificial, there is more of Nature than Art. Industry and Art may bring Materials and place them fitly for it, but Nature works them", and concluded that "it is the great Art of Man to find out the Arts of Nature". Despite his fascination with the new science and its promise, Sharrock (pious clergyman that he was), gave nature – God's creation – the upper hand. However, as we shall see in future lectures, the question of the proper relationship between nature and culture is a complex one that is still being debated today, for example in arguments about genetically modified plants. Some scientists see technologies such as gene editing as fulfilling Bacon's dream; they will allow us to make new plants to meet our needs, to feed the hungry and cure the sick. For others, of course, this interference with nature is a grave mistake (scientists 'playing god', is one way of putting it). These debates will recur in this series, and are a reminder of the deep ambiguity at the heart of the idea of utopia. When Sir Thomas More coined the term "utopia" to describe an ideal world he deliberately made a pun (in Greek): if the word were spelt *ou-topos* it would mean 'no place' (or 'nowhere'), but if it were spelt *eu-topos* it would mean 'good place'. The very word 'utopia' embodies the deliberately paradoxical claim that a perfect world is desirable but cannot (or perhaps should not) exist. And that original ambiguity has, of course, been compounded by the fact that what Bacon called "enlarging the bounds of human empire" has often been experienced as imperialism, violence, or the rape of "Mother Nature". One person's idea of heaven (utopia) is often another's idea of hell (dystopia).

Further Reading

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Svensson, Anna (2019) "'And Eden from the Chaos rose': utopian order and rebellion in the Oxford Physick Garden". (*Annals of Science*).
"Utopia", a rich overview of the tradition at the British Library, https://www.bl.uk/learning/histcitizen/21cc/utopia/utopia.html