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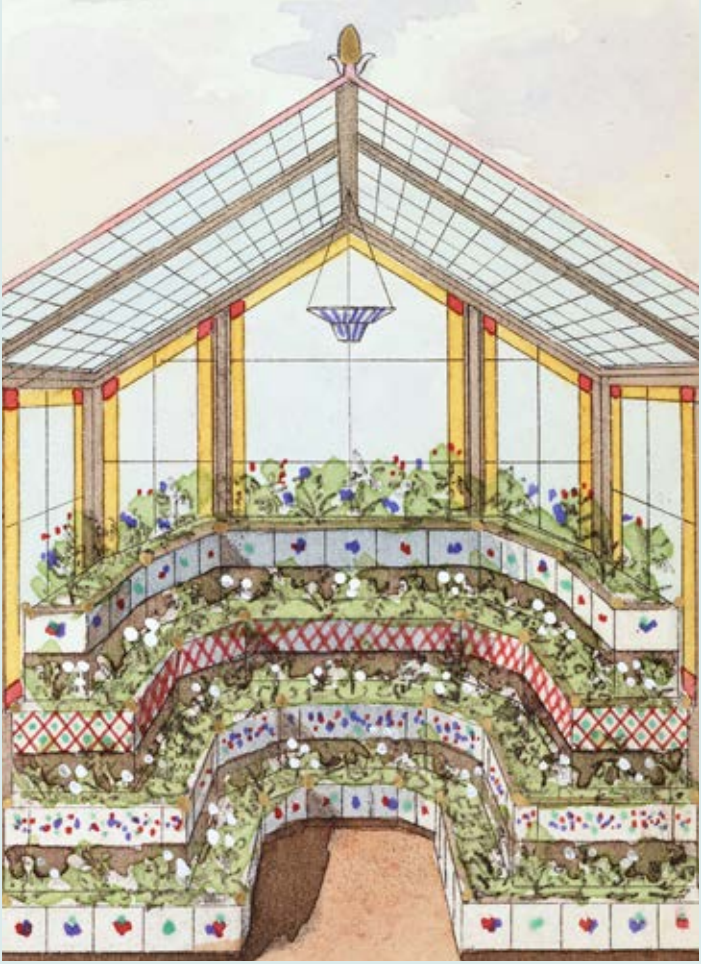

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Volume 17, October 2019

The architectural, horticultural and social history of glasshouses

Cover illustration:

View of the interior of a conservatory, showing flower stands, lithographed after an original by W. Butler, from James Mangles (1786–1867): *The Floral Calendar*, London, 1839.

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Volume Seventeen

October 2019

A world under glass: the architectural,
horticultural and social history of glasshouses

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Introduction

The world-renowned collections in RHS Libraries contain within them a wealth of fascinating information on the history of horticultural practice and the development of garden design. This features not only the people and plants that shaped our horticultural heritage, but also records of the structures that lent both form and function to their cultivation. In particular, there is a rich narrative regarding glasshouses.

Volume 17 of the *Occasional Papers from the Lindley Library* charts the rise and decline of these glass edifices – examining shifting tastes from the 17th–20th century that dictated style, as well as chronicling the developments in engineering and technology that allowed these structures to assume shapes never before imagined and functional capabilities which catered for evolving modern demands. The papers in this edition make clear that glasshouses, far from being hidden utilitarian features, have historically straddled the gamut as overt displays of wealth, treasure houses of exotic plants and plant collecting prowess, through to signifiers of artistic taste and indicators of social change. Beyond the juxtaposition of aesthetic and practical concerns, we are introduced to the social aspects of glasshouses and their influence on engagement and interaction with garden spaces. The reader will be presented with consideration of these structures as gendered spaces, with discussion focusing on the interconnectivity of the glasshouse and the domestic sphere and how this helped to facilitate the breakdown of barriers for women in horticulture and botany.

Through the articles contained in the journal, the reader will gain a compelling insight into the influential factors that have impacted upon the design, functionality and perception of glasshouses through the ages.

Horticulture under glass

Edward Diestelkamp
c/o The RHS Lindley Library, The Royal Horticultural Society, London

The development in the late eighteenth and nineteenth centuries of special buildings to nurture and protect plants from adverse weather conditions is fascinating for the number of different approaches devised and advocated by gardeners, horticulturists, designers and writers. Ideas surrounding the optimum form and preferred structural materials were discussed and published in proceedings, journals, books and catalogues, and many experimental structures of varying form were erected. Some of the concepts were innovatory, while others were derived from traditional approaches, materials and methods of construction. The way in which materials were combined to create forms enclosing space and providing accommodation for plants was quite varied and some concepts would be adopted for other types of buildings. During the same period there were many advances in methods of heating and ventilation, utilising new techniques and specially designed machinery.[1]

In the latter part of the seventeenth century, structures for overwintering and nurturing tender plants were erected in Britain. Greenhouses and 'conservatories' (a term first used by John Evelyn) could be simple structures. In *Kalendarium Hortense* (1691), Evelyn published a plan, elevation and details of the greenhouse or conservatory that he had erected for the purpose of 'enclosing… tender plants and perennial greens and shrubs' (Evelyn, 1691). He recommended in November, 'secluding all entrance of cold and especially sharp winds' and placing plants in the greenhouse, where they should be 'refreshed sparingly with qualified water'. 'If the season prove exceedingly piercing', he recommended one should 'kindle some charcoals sunk into a hole in the floor'. The engraved illustration (Fig. 1) shows a simple gable-ended building of rectangular form. The front wall was fitted with glazed wooden sash frames, and the framing of the three solid walls may have been in timber. The thickness of the solid walls of the building is shown slightly narrower than the thickness of the walls of the stove and the chimney, the latter of which he explained could be made of brick or Reigate stone. The height, he

[1] Hix, 2005; Grant, 2013 and Woods & Warren, 1988, offer a survey of these developments.

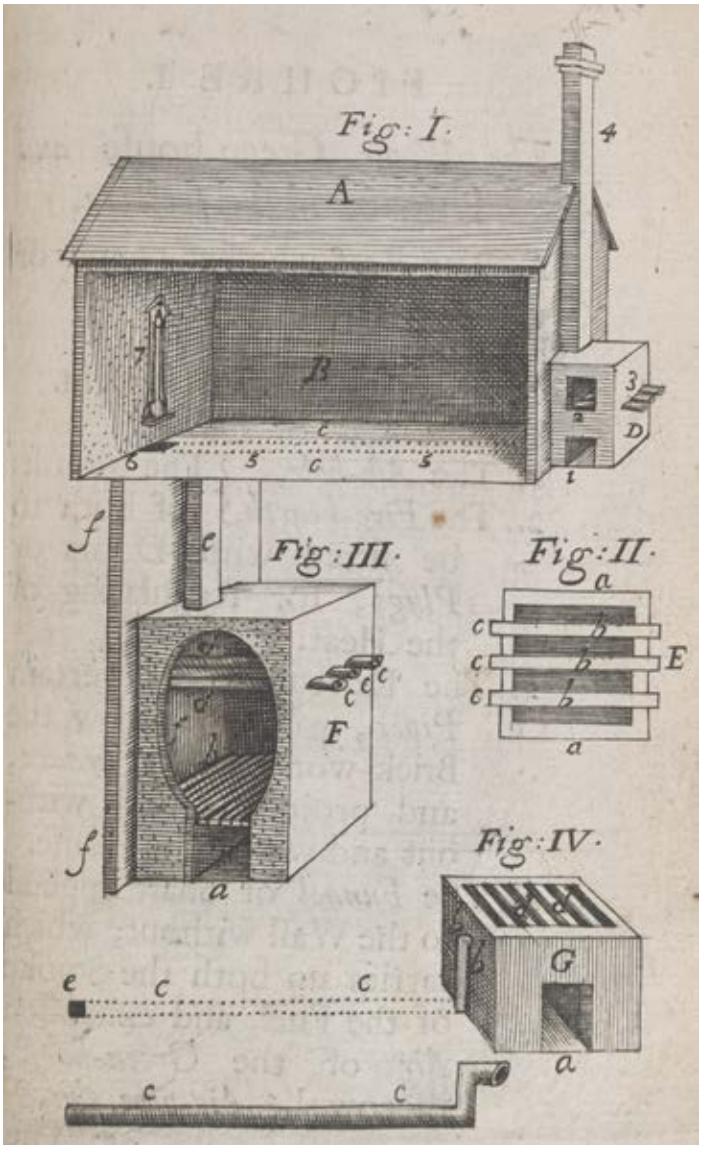

Fig. 1. John Evelyn's greenhouse from *Kalendarium Hortense*, 1691. RHS Lindley Collections.

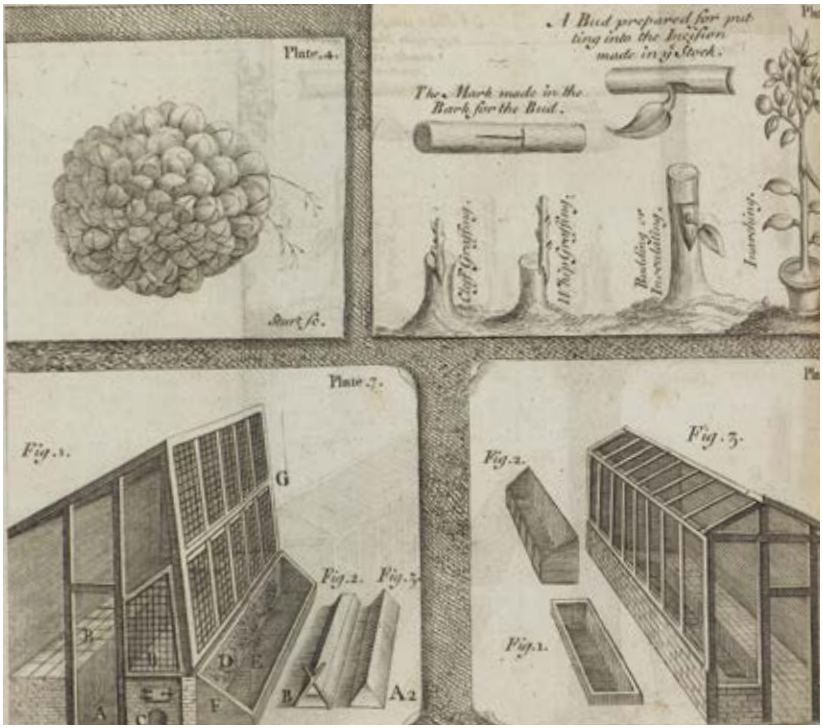

Fig. 2. From Richard Bradley's *New Improvements of Planting and Gardening*, 1739. RHS Lindley Collections.

recommended, should be ten to eleven feet and the width twelve to thirteen feet, while the length could be extended to provide the accommodation needed. Evelyn was very concerned about the quality of the air within the greenhouse and proposed introducing cast-iron pipes for the purpose of bringing fresh air from the outside into the building. These were routed through the furnace where they would conduct the heat of the fire, thereby warming the fresh air as it entered the greenhouse. The vitiated air was collected in a duct running beneath the floor.

Evelyn encouraged the use of well-seasoned timber and employment of a skilful workman for the doors and sashes. These, he recommended, should be carefully fitted and the glass well-cemented, as he recognised their importance

in preventing the entrance of cold air. He also advocated the introduction of a porch at one end of the building where an air lock could be created.

In late 1689, three timber-framed glass cases with steeply sloping glazed front elevations were erected at Hampton Court Palace by a Dutch carpenter, Hendrik Floris, to house the remarkable collection of exotics formed by William and Mary (Jacques & Van der Horst, 1988, pp. 178–179). In the latter seventeenth century and eighteenth century, this upright form of glasshouse was common on the Continent, especially in the Low Countries and in the German states. Richard Bradley illustrated a glasshouse of similar form in *New Improvements in Planting and Gardening* (Bradley, 1739). The steeply sloping front and vertical side elevations were glazed with leaded lights supported on mullions and transoms, while the rear wall and a single pitched roof (sloping towards the rear wall) were solid (Fig. 2). Inside, a central path ran between two raised shelves constructed of brickwork on which potted plants stood. A fireplace and flues were housed within the plant shelf at the front of the building, beneath the glazed elevation. At the Botanic Garden in Oxford, similar timber glass cases with steeply sloping glazed elevations were erected in 1734 on either side of the Danby Gate, as illustrated in a view published in the *Oxford Almanac* of 1766.[2]

Low-pitched glazed roofs supported on vertical glazed front and end walls became the general form of timber glasshouses more commonly adopted in Britain in the eighteenth and nineteenth centuries, like the ones appearing in the frontispiece of Thomas Fairchild's *The City Gardener* of 1722 (Fairchild, 1722). Some seventy years later William Speechly in *A Treatise on the Culture of the Pine Apple, and the Management of the Hot-House* (first published 1779) would illustrate a 'Pine and Grape Stove' of similar form (Fig. 3). Speechly was Head Gardener to the Duke of Portland at Welbeck Abbey and in this treatise he recorded designs for five different kinds of hothouses based upon his many years of experience in growing exotics and fruiting plants. These designs also reflect developments in flued hot air and steam heating systems, as well as theories related to the optimum angle of a glazed roof to benefit from the sun's rays at certain times of the year. Note for instance the way in which the hot air flue ducts are detached from the low brick walls – thereby minimising the loss of heat through conductivity with masonry elements of the building.

The symmetrical arrangement of a greenhouse of masonry or brick construction, flanked on either side by low-pitched timber forcing or

[2] Green, B., engraving after Wale, S., 1766.

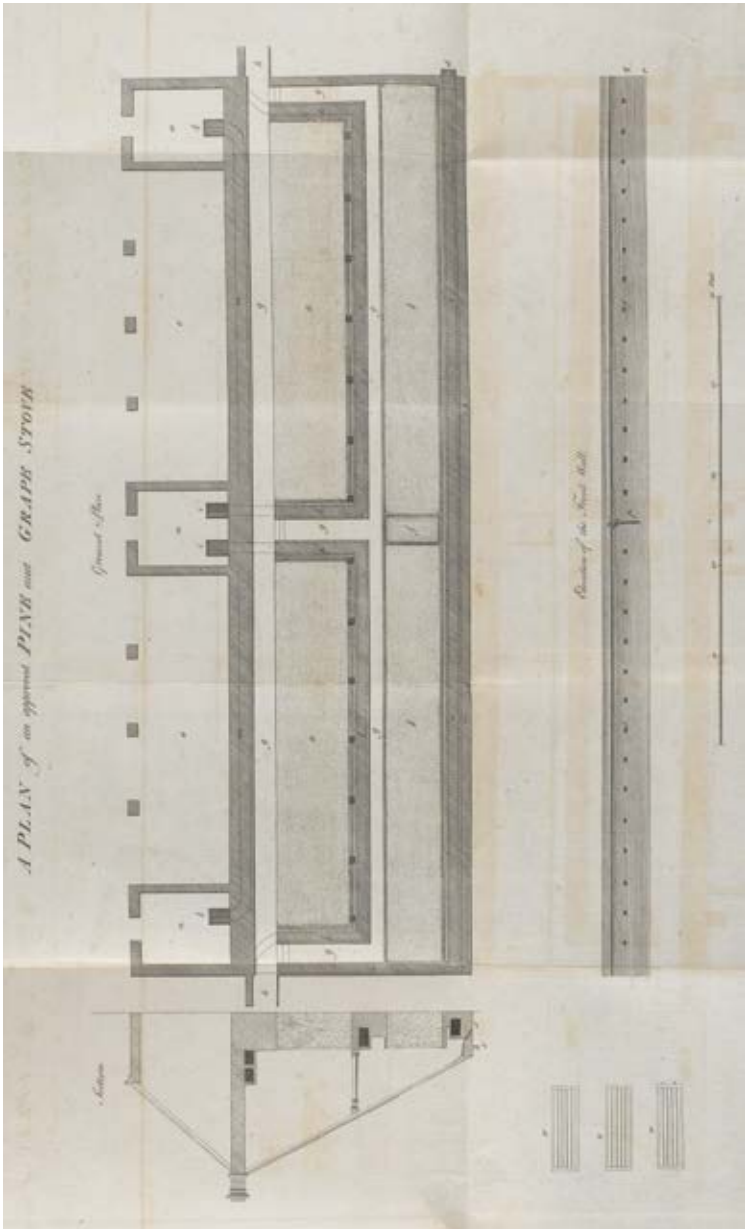

Fig. 3. From William Speechly, *A Treatise on the Culture of the Pine Apple and the Management of the Hot House*, 1779. RHS Lindley Library Collections.

Fig. 4. Orangery and greenhouses, Calke Abbey, Derbyshire, elevation, 1777. © Reproduced by kind permission of the National Trust. Photo: Edward Diestelkamp.

Fig. 5. Hothouses for pineapples and vines, Wimpole Hall, Cambridgeshire,designed 1792, restored 1999. National Trust Images/Andrew Butler. © Reproduced by kind permission of the National Trust.

fruiting glasshouses, became common by the early nineteenth century. The greenhouse erected in 1777 in the walled garden at Calke Abbey (Derbyshire)[3] with large arched glazed openings along the front elevation, was flanked on either side by timber-framed fruit houses, of which only the eastern one now survives (Fig. 4). The roof of the central greenhouse is surmounted by a glazed iron-framed dome, added in 1836 by the civil engineer John Harrison of Derby, as an 'improvement' to allow more light inside.

At Wimpole Hall in Cambridgeshire[4], a symmetrical range of hothouses for pineapples and vines was erected at the end of the eighteenth century to a design created by John Soane in 1792. The range was entirely timber-framed and comprised a central plant house flanked on both sides by lean-to ranges, one for vines and another for pineapples. Badly damaged in the Second World War by enemy bombs, the remaining fragment was demolished following the war and in 1990 the range was restored using Soane's original drawings (Fig. 5).

George Tod's *Plans, Elevations, etc. of Conservatories* of 1807 is a repository of early nineteenth-century designs for conservatories, hothouses, and glasshouses of different forms (Tod, 1807). The plate of *Two Peacheries and A Green House Erected for The Right Honble. Lord Heathfield at Nutwell Court, Devon* (Fig. 6) illustrates a symmetrical timber-framed range of lean-to glasshouses comprising a higher and broader central greenhouse, with staging in the centre for displaying exotics and treillage supporting climbing plants on the back wall. The timber rafters of the roof spans of the centre house and wings are shown supported on alternating cast-iron columns and iron arches. Iron was gradually introduced in the construction of greenhouses during the late eighteenth and early nineteenth centuries. Francis Augustus Elliott, 2nd Baron Heathfield, had inherited Nutwell Court from his uncle, the 5th and last Sir Francis Drake, and in 1799 he replaced the old house with a severe neoclassical mansion designed by S.P. Cockerell. The new glasshouse range was erected around that time.

The early nineteenth-century symmetrical timber range of glasshouses at Kelvin Grove, Co. Carlow, erected some time in the 1830s or 1840s, features a central bay-fronted ornamental plant house flanked on either side by two lean-

[3] Calke Abbey is a National Trust property which is open to the public. For further details, go to www.nationaltrust.org.uk.

[4] Wimpole Hall is a National Trust property which is open to the public. For further details, go to www.nationaltrust.org.uk.

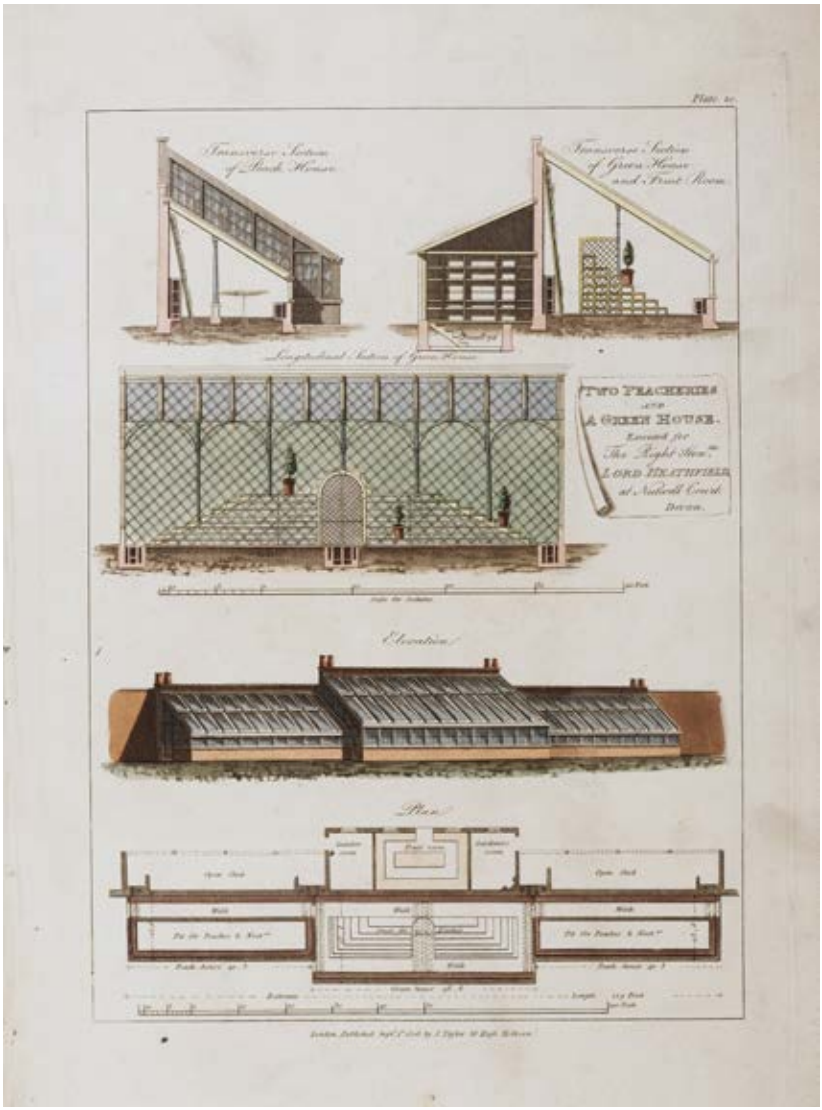

Fig. 6. Two peacheries and a greenhouse for Lord Heathfield, Nutwell Court, Devon, in George Tod, *Plans, Elevations, etc of Conservatories*, 1807. RHS Lindley Collections.

to fruit houses. This arrangement was common and continued to be popular throughout the rest of the century. The relationship of the dwelling house to the glasshouse is particularly interesting as the latter does not stand within a walled garden, but instead is placed on the edge of the flower garden onto which the main reception rooms of the house look. J.C. Loudon advocated such an arrangement and it became commonly adopted in suburban villas of the 1820s–1840s (Loudon, 1838). The more decorative appearance of the central plant house with architectural pilasters and castings adopts an ornamental character appropriate to its setting.

The introduction of iron in glasshouses as a constructional material for reasons of strength, durability and slenderness of form when compared with timber, was advocated by some eighteenth- and early nineteenth-century writers on horticulture and architecture. An early example is found in Michel Adanson's treatise *Famille des plantes* of 1763 (Fig. 7). This illustrates a glasshouse constructed of an iron frame, with slender vertical iron mullions supporting glazing fixed to metallic glazing bars (Adanson, 1763). In the mid-eighteenth century, metallic glazing bars were introduced into skylights within staircase halls. Architects like James Wyatt, Samuel Wyatt, Humphry Repton, John Nash, Jeffry Wyattville, Decimus Burton and others would use iron in the late eighteenth and early nineteenth centuries for framing glazing and for structural members in buildings such as the slender columns and arches in G. Tod's design for the glasshouse range at Nuttwell Court.

The adoption of cast metals for glazing bars and structural members offered advantages over timber. The production of large numbers of identical glazing bars or structural members from a single mould could be easily achieved, and molten metals could adopt curved or angular shapes replicating the form of the mould. Creating such forms in timber could be more time-consuming and costly. An early nineteenth-century glasshouse illustrating the advantages of cast-iron framing over timber, can be seen in the design of an *Ornamental Hot-House Window, Made of Cast Iron and Stained Glass*, that was done for William Harwood Folliott of Stapeley House, Chester (Fig. 8). Making an elaborate Gothic window with curved and faceted glazing bars would have been more difficult and complicated in timber, which as a framing material could not have matched the slenderness of the vertical and horizontal cast-iron members.

Horticulturists, gardeners and writers were very interested in the optimum form and design of glasshouses at this time. The possibility of using cast iron to create a domical or spherical form was recognised by Sir George

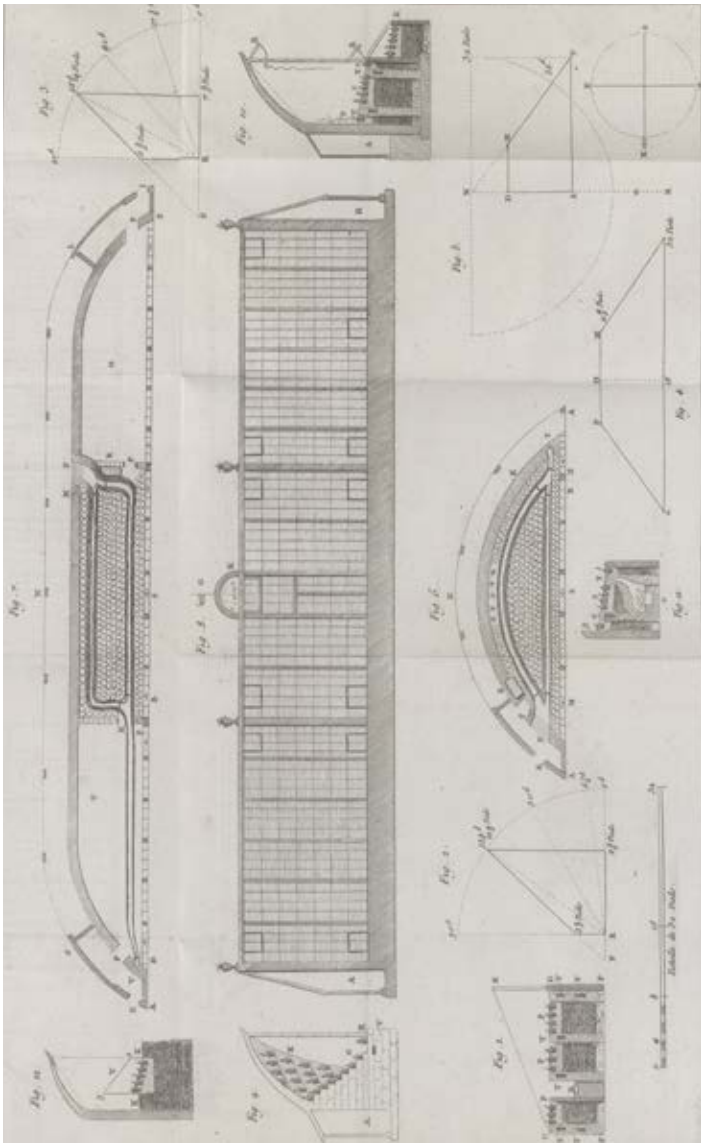

Fig. 7. From Michel Adanson's *Familles des plantes*, 1763. RHS Lindley Collections.

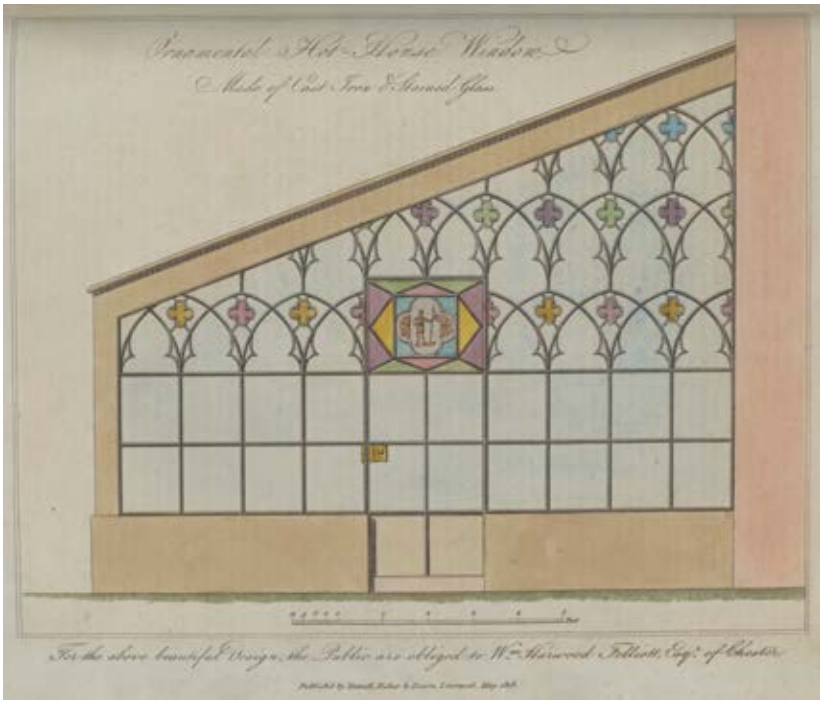

Fig. 8. William Harwood Folliott's ornamental hothouse window of cast iron, as printed in Thomas Green's *The Universal Herbal*, Vol. II (1820). RHS Lindley Collections.

Mackenzie, horticulturist, geologist and agricultural improver. In 1815, he proposed that the optimum form of a hothouse should be a quarter sphere, in which the surface of the glass would be parallel to the vault of the sky (Mackenzie, 1817, p. 173).

Significant developments in rolling wrought iron to create structural forms occurred in the early nineteenth century that when applied to the design of glasshouses led to some remarkable structures. Wrought iron has greater tensile strength than cast iron, while possessing nearly identical strength in compression. It is more malleable and with the application of heat can be bent into shapes, unlike cast iron which is brittle and will break under lateral

pressure. The invention in 1816 of the wrought-iron glazing bar by John Claudius Loudon was actually achieved by W. and D. Bailey, Ironfounders of Holborn in London (Loudon, 1817, figs 37 and 38). In 1818, they entered a patent on the invention and during the 1820s and 1830s were commissioned to erect a number of remarkable curvilinear glasshouses in Britain. One of the earliest examples of their work that is standing today was erected in 1820 at Downton Castle in Shropshire for Thomas Andrew Knight, botanist, horticulturist and second President of the Royal Horticultural Society (Fig. 9). Two years later the Baileys erected a curvilinear hothouse for the geologist George Bellas Greenough at his villa in Regent's Park, Grove House.

Curvilinear wrought-iron glasshouses were quite popular in the middle decades of the nineteenth century and many were erected by the Baileys of Holborn. Richard Turner, Ironfounder of Ballsbridge (Dublin), built many examples in Ireland as well as in England and Scotland (Hix, 2005, pp. 138–150). His most significant commission perhaps was the Palm House at Kew Gardens, which he erected between 1844 and 1848. An earlier commission was the range of fruit houses and greenhouse he built in the walled kitchen garden at Colebrook, Co. Fermanagh erected between 1833 and 1834. During the 1820s to 1850s there were a number of firms in England, some such as Richards and Jones, Jones and Clark, Thomas Clark and Henry Hope that were based in Birmingham, one of the centres for metallic trades, as well as in other parts of the country, specialising in the manufacturing and erection of wrought-iron glasshouses. William Crosskill of the Beverley Iron Works also specialised in the design and installation of hot water heating systems of glasshouses, as well as other types of buildings. The manufacturer of the elegant 1830s lean-to curvilinear glasshouse at Felton Park, near Morpeth (Fig. 10) in Northumberland, is not known. Recently restored as originally designed, it houses fruit trees espaliered against the back wall and vines suspended on wires beneath the surface of the roof, an arrangement that was very widely followed (Beamish, 2016).

At the time iron became a popular material for glasshouses, Joseph Paxton, Gardener to the Duke of Devonshire, was exploring different ways of using timber for erecting glasshouses. A number of experimental timber and glass structures were erected at Chatsworth (Chadwick, 1961, pp. 72–103). Specially moulded glazing bars were developed in the estate workshop to create the 'ridge and furrow' glazed roof that Paxton had devised. His preference for timber over iron was based on economy and ease of manufacturing, erection and maintenance. Paxton's 'ridge and furrow roof' was composed of short

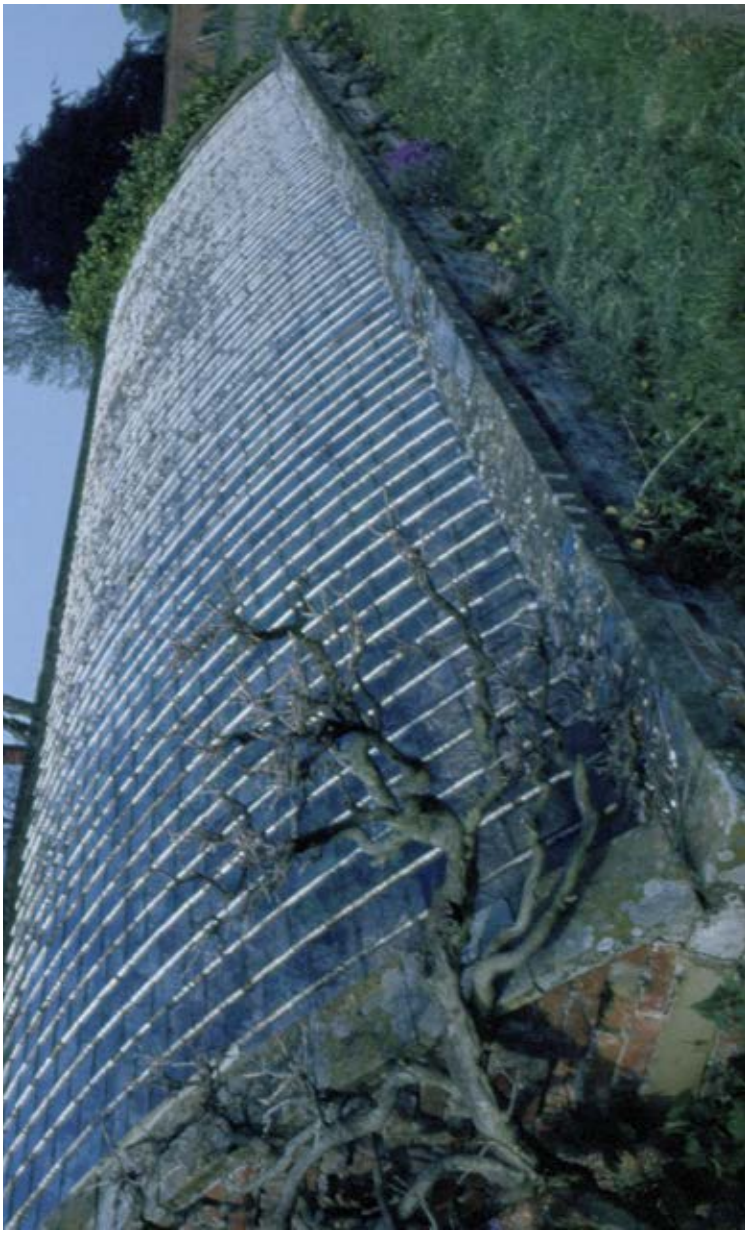

Fig. 9. T. A. Knight's curvilinear pinery, Downton Castle, Herefordshire, 1820. Reproduced by kind permission of Downton Castle. Photo: Edward Diestelkamp.

Fig. 10. Felton Park, Northumberland: vinery and peach house. Reproduced by kind permission of Felton Park. Photo: Edward Diestelkamp.

glazing bars of standard length supported on moulded timber rafters. In his *Magazine of Botany*, he advocated the merits of this construction that could be easily repaired by estate staff rather than by specialists (Paxton, 1835, pp. 80–81, 253). The 'ridge and furrow' horticultural structures Paxton erected at Chatsworth during the 1830s and 1840s were of rectilinear as well as curvilinear form. A vinery erected at Lismore Castle, Co. Waterford, in 1853 is closely based on Paxton's designs for a greenhouse that he erected at Chatsworth. Two thirds of the glasshouse still stands, and is possibly the only greenhouse to Paxton's design known to survive. The camellia house standing in the centre of the glasshouse range in the kitchen garden at Stratfield Saye in Hampshire adopts the 'ridge and furrow' design, and although there is not any known involvement by Paxton in its design or erection, the Duke of Wellington had been at Chatsworth in 1843 when Queen Victoria and Prince Albert visited the 4th Duke of Devonshire, shortly after the great conservatory and greenhouse had been completed.

Timber remained the most widely adopted material for erecting glasshouses during the nineteenth century and many firms throughout the country produced well-designed, economical structures in a range of sizes. Traditional sliding, hinged or fixed timber sashes made up of timber glazing bars supporting sheets of glass, carried on sloping timber roof rafters or vertical timber mullions or stanchions, were manufactured by many companies throughout the country. These included companies such as Boulton & Paul of Norwich; James Boyd & Sons of Paisley; James Cranston of Birmingham; Foster & Pearson of Beeston, Nottinghamshire; J. Gray , London; R. Halliday & Co. of the Royal Horticultural Works, Middleton, Manchester; Mackenzie and Moncur of Edinburgh; Messenger & Co. of the Midland Horticultural Works, Loughborough; H. Ormson of King's Road, London; James Hartley and Co. of the Wear Glass Works, Sunderland; Messrs W. Richardson of Darlington; and J. Weeks & Co. of Chelsea, London. Numerous articles and advertisements for the work of these and many other firms regularly appeared in gardening and horticultural journals.

New and different forms for glasshouses, as well as new methods for combining glass with structural materials, were devised by a number of firms and as the century progressed, manufacturers continued to develop new designs. Firms such as the Imperishable Hothouse Company of Newark upon Trent, which manufactured greenhouses to Ayres' patent design; W.E. Rendle of Plymouth; and Skinner & Board Horticultural Works, Stoke Croft, Bristol, are but a few of many that devised ways of utilising materials including

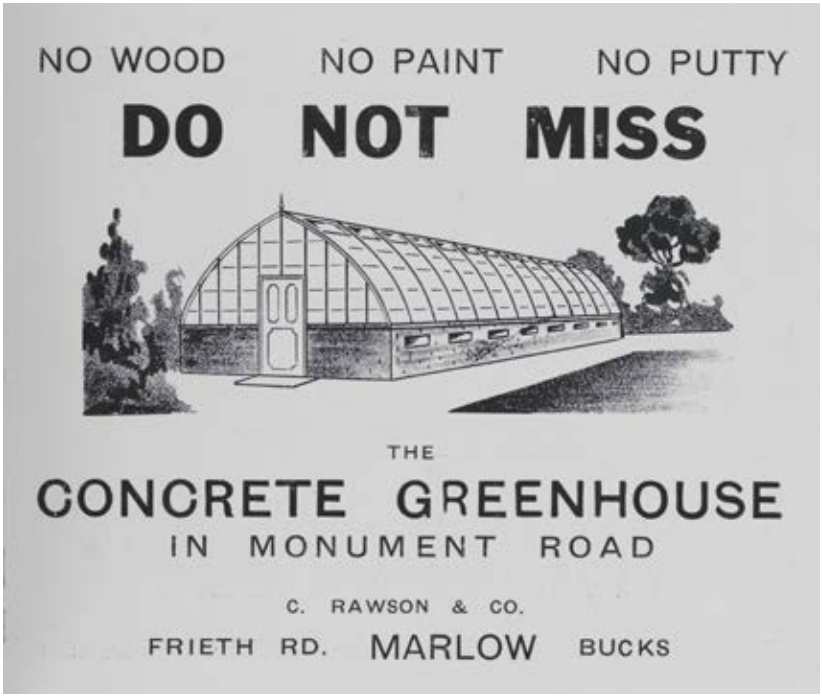

Fig. 11. Advertisement for the concrete greenhouse by C. Rawson & Co. Taken from page xxvi of the 1929 Great Spring Show catalogue. RHS Lindley Collections.

new ones such as gutta-percha or rubber, to minimise maintenance and maximise performance. Greenhouses in the kitchen garden at Ickworth near Bury St Edmunds, Suffolk, erected by the local firm of G. Beard and Sons in the 1880s, incorporate a novel use of rubber gaskets to seal the edge of the glass against the iron glazing bar and iron frame, which was patented in 1879. The rectilinear sloping form of roof with generous wide panes of glass held in place by modest, thin iron glazing bars offered minimal restriction to light penetrating through the glass roof. By the time the extensive range of lean-to greenhouses had been erected at Tyntesfield in North Somerset in 1896 to the same design, Beard's patent had been passed to W.G. Smith of Ipswich, who were responsible for constructing a highly efficient range of galvanised iron

greenhouses with sophisticated mechanical devices for opening ventilating sashes in the front elevation as well as along the length of the ridge. Designed as a highly efficient machine for growing plants, the range was manufactured to a very high standard.

Reduction of the cost of maintenance was a common objective of many innovations developed in the late nineteenth and early twentieth centuries. Like many greenhouse manufacturers of the nineteenth and early twentieth centuries, Skinner and Board of Bristol were renowned for their hot water heating systems. One of the inventions developed by the firm was a system for attaching the glass panes to tensioned wires with metal clips, thereby internalising the structure as well as the fixing method within the building where they would be shielded from the elements and less prone to rust. Galvanised clips secured the edges of the glass to tensioned wrought-iron wires supported by vertical iron stanchions. This ingenious system was intended to reduce the routine costs of maintenance commonly associated with traditional timber glasshouses of re-puttying glass and repainting of timber sashes and frames. The lean-to glasshouse formerly at Hoole Hall, near Chester, was erected by the firm in the early years of the twentieth century.

By the later years of the nineteenth century and early years of the twentieth century, firms producing greenhouses were located across the country. Bigger ones also specialised in erecting large-scale structures such as conservatories and winter gardens in addition to producing more modestly scaled greenhouse ranges. Mackenzie and Moncur of Edinburgh was one of a number that erected large structures in public parks and municipal gardens. W. Richardson of Darlington were widely engaged in installing heating systems and producing ranges of traditional timber-framed greenhouses and conservatories such as the range erected by the firm for Lord Dunleath at Ballywalter Park in Co. Down in the early years of the twentieth century.

During the late 1920s and 1930s there were developments in the use of concrete reinforced by iron rods and wires to create structural frames for greenhouses. These frames supported glass panes as well as hinged concrete-framed sashes for ventilation. Concrete was thought to offer certain advantages over timber and iron in the relative minor risk of rot or decay caused by moisture. There were, however, disadvantages arising from the relatively large section of the structural members. The shortage of building materials during and following the Second World War led to the adoption of concrete greenhouses. The example in the walled kitchen garden at Llanerchaeron in Ceredigion was erected in the years following the war and is still in regular

use. Like designers and theorists of earlier centuries, common objectives of durability and minimising on-going costs of maintenance had led thinking in developing new ideas and inventions, though concern for maximising the amount of light admitted inside was not as important a priority.

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Biography

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Paxton, the Victoria leaf, and the Crystal Palace

Brent Elliott
c/o The RHS Lindley Library, The Royal Horticultural Society, London

There is a legend which has often been repeated: Paxton based the design of the Crystal Palace on the structural principles of the leaf of the Amazonian waterlily, *Victoria regia* (now *Victoria amazonica*). When I first encountered this legend, I assumed that it was the result of a confusion between the *Victoria regia* and the Victoria House at Chatsworth, the acknowledged prototype for the Crystal Palace, and that it was a fairly recent error. George Chadwick propagated the legend in his book on Paxton (Chadwick, 1961, p. 101), footnoting a reference to a lecture that Paxton gave to the Royal Society of Arts in 1850, though this text did not make any such claim (see below). But the story was old long before Chadwick. J.G. Wood, in one of his books on natural history, said:

> Mr. Paxton saw how this power was obtained, and the result was that he copied in iron the lines of the vegetable cellular structure which gave such strength to the Victoria Regia leaf, and became more eminent as an architect than he had been as a gardener (Wood, 1877, p. 196).

The grid-like pattern of the roof glazing of the Crystal Palace is hardly a copy of the radiating ribs of the roughly circular leaf. So what is the source of this legend?

Let us remind ourselves of the chronology of events. In 1838 Robert Schomburgk reported his discovery in South America of a waterlily with an enormous flower. He sent a specimen which arrived in England largely decayed. With the aid of his drawing John Lindley published a description of the plant which he named *Victoria regia*. Thomas Bridges successfully sent seeds to England in 1847. Plants were raised at Kew and then at Chatsworth, where Paxton got the plant to flower in 1849.[1]

A few months later, Paxton built a new glasshouse to which he transferred the *Victoria*. This building was the prototype for the Great Exhibition building.

[1] Accounts of all this can be found in the *Illustrated London News,* 17 November 1849a, p. 328 and in the *Gardeners' Chronicle*, 24 November 1849, pp. 739–741, with correspondence in 1 December 1849b, p. 758.

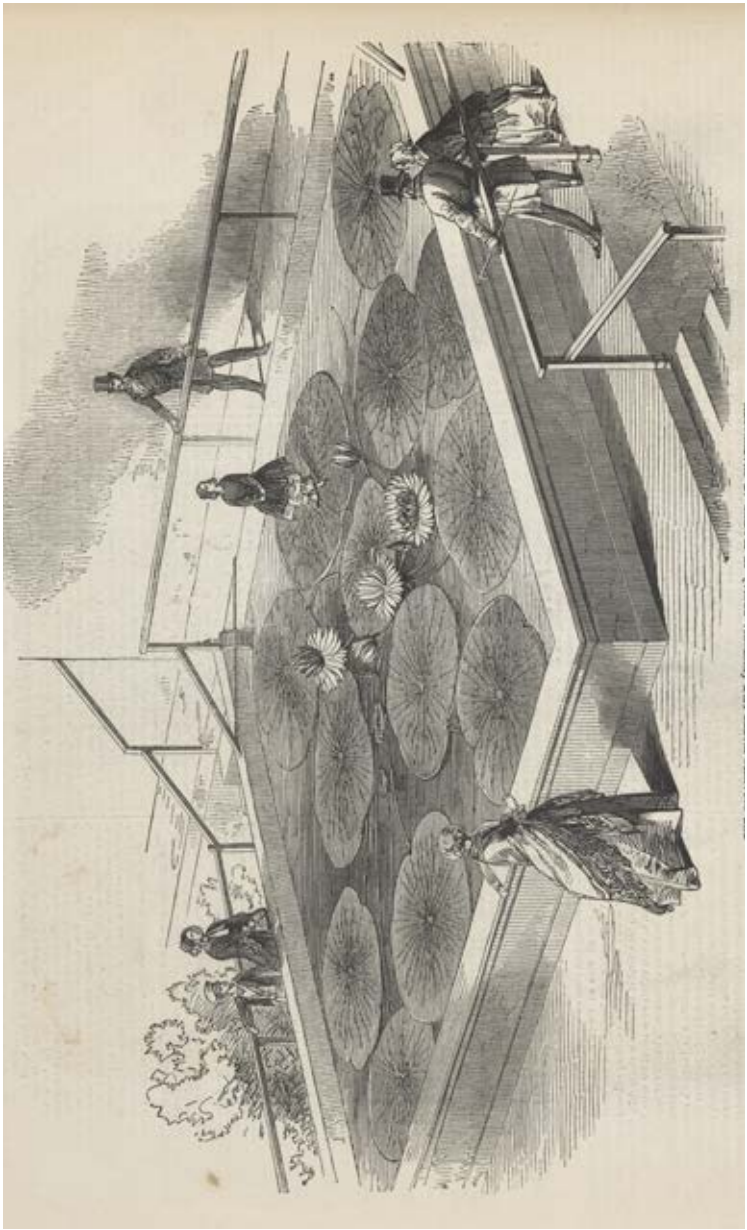

Fig. 1. The gigantic waterlily (*Victoria regia*), in flower at Chatsworth. *Illustrated London News*, 17 November 1849. Wellcome Collection.

Already in 1849 Paxton had demonstrated the load-bearing properties of the *Victoria* leaf by posing his daughter Emily standing on it. The illustration in the *Illustrated London News* (*ILN*) quickly became famous. The association between the monster waterlily and the gardener who had flowered it was established. *Punch*, in August 1850, invited Paxton to take over the plans for the Houses of Parliament, asking him 'to clap on your considering cap – that pretty, tasteful thing, bent from a leaf of the *Victoria Regia*, and the matter is done' (Anon., 1850e, p. 81).

During Paxton's lecture to the Royal Society of Arts in 1850, he also exhibited one of the large umbrella-shaped leaves of the *Victoria regia* lily, exciting much interest. A report on the lecture in *The Times* included the following passage:

> You will observe that Nature was the engineer in this case. If you examine this, and compare it with the drawings and models, you will perceive that nature has provided it with longitudinal and transverse girders and supports, on the same principle that I, borrowing from it, have adopted in this building (Anon., 14 November 1850c, p. 4).

This seems unambiguous – but wait. There are two other published accounts of that lecture, neither of which includes the statement about indebtedness to the *Victoria* leaf. The first of these is an abstract of the talk, which was published in the Royal Society of Arts (RSA) *Transactions* (Paxton, 1850, pp. 1–6). It is impossible to tell whether this was compiled by the Secretary of the Society, or was based on an abstract provided by Paxton himself, as the Society's archives have preserved only the printed text.

The second is a report in the *ILN* (Anon., 16 November 1850d, pp. 385–386). Like that in *The Times*, this is a verbatim transcript. The two newspaper versions are largely identical – a testimony to the shorthand skills of the reporters. But there are a few differences. The *Times* reporter contented himself with noting that Paxton 'was frequently cheered in the course of his statement', while the *ILN* reporter noted every single burst of cheers. The *Times* reporter mistakenly gave the date of the first flowering of the waterlily at Chatsworth as 'November 9, 1849', while the *ILN* reporter got it right, '8th November 1849'. The *Times* report abridges Paxton's account of two early experiments with the new roofing system. And the *ILN* text contains nothing like the sentences quoted from *The Times* above.

The *Transactions* text includes this note, inserted after the main report:

> The paper was accompanied by a very large number of drawings, views, and diagrams, and by one of the sash-bar machines. The most interesting illustration was a specimen of the leaf of the Victoria regia, five feet in diameter, the growth of five days. The underside presents a beautiful example of natural engineering in the cantilevers which radiate from the centre, where they are nearly two inches deep, with large bottom flanges and very thin middle ribs, and with cross girders between each pair to keep the middle rib from buckling; their depth gradually decreases toward the circumference of the leaf, where they also ramify (Paxton, 1850, p. 6).

But no statement of influence on Paxton's design. In the same year Paxton made two further statements: a talk in Derby, the transcript of which was published in the *ILN* (19 October 1850b, pp. 322–323), and an article in the *Gardeners' Chronicle* (31 August 1850a, pp. 548–549), the newspaper which Paxton had founded a decade before. Neither of these includes any statement about indebtedness to the *Victoria* leaf.

Next question: does the legend about indebtedness to the *Victoria* leaf make sense, chronologically? All three versions of the RSA lecture quote Paxton as summarising the development of his system. First, the use of a ridge-and-furrow glazed roof, then the use of ridge-and-furrow in a flat roof. He first attempted the latter in a house in Darley Dale (Darley House). The newspapers do not give a date for this, but the RSA *Transactions* gives the date as 1840:

> In a conservatory at Darley Dale, in 1840, Mr. Paxton first employed the ridge-and-furrow roof on a level, that is, neither curvilinear nor inclined, as in the former cases. ... This was more extensively carried out in the new Victoria Regia house ... which on its small scale is a perfect type of the Great Building (Paxton, 1850, pp. 1–2).

The Times abridges the transcript of the talk at this point, but the *ILN* contains the following: 'from the various uses to which this little structure has been applied, nothing can be more evident than that this style of building is exactly suited for the purposes of the Industrial Exhibition'. However if the first prototype for the Great Exhibition building was built in 1840, the best part of a decade before the *Victoria regia* was successfully grown in England, it can hardly have been based on practical experience of the plant's anatomy.

Fig. 2. *Victoria regia* by Robert Hermann Schomburgk (1804–1865), printed in John Lindley's *Victoria regia* (1837). ('A notice of Victoria regia, a new nymphaeaceous plant discovered by Mr. R.H. Schomburgk in British Guayana.') RHS Lindley Collections.

Could Paxton have been alerted to the structural qualities of the *Victoria* leaf by reading botanical descriptions of the plant before it had arrived in Britain? Robert Schomburgk's original description concentrates on the flower; of the ribs he says only that they 'are very prominent, almost an inch high, radiating from a common centre' (Lindley, 1837, pp. 1–2). His illustration paid little attention to the ribbed structure of the leaf. Paxton made it clear that the load-bearing capacity of the leaf was his discovery, once he had seen it growing at Chatsworth:

> Early in November, the leaves being four feet eight inches in diameter, and exhibiting every appearance of possessing great strength from the deep thick ribs … I was desirous of assessing the weight which they could bear, and, accordingly, placed my youngest daughter, eight years of age, weighing forty-two pounds, upon one of the leaves (Hooker, 1851, p. 17, and see *ILN*, 17 November 1849a, p. 328).

So the load-bearing capacity of the leaf was Paxton's discovery, in 1849. If the Victoria House, and after it the Crystal Palace, were built using a system that Paxton was already using in 1840, there is no way it could have been inspired by the *Victoria* leaf.

A bungle in *The Times*, probably the result of their reporter misinterpreting his notes, appears to be the source of the legend. But it was probably helped on its way by a further misinterpretation, of an article in Charles Dickens' magazine *Household Words*, by his co-editor W.H. Wills. In a rather florid account of an unpredictable chain of cause and effect, Wills points out that the discovery of *Victoria regia* led to its introduction into England and the publicity given to its flowering, which led to Paxton building a separate house for it, which he used as the prototype for the Great Exhibition building; 'by a curious apposition, the first parent of the most extensive building in Europe was the largest known floral structure in the world' (Wills, 1851, p. 385). There is no assertion of indebtedness for design, but careless reading could easily make that inference. And so an entertaining paradox helped to spread a legend which has bedevilled architectural history ever since.

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Georgian and Regency conservatories: their structural and social integration with the house

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Introduction

The orangery, or hothouse as they were usually called, had been for centuries the preserve of the very wealthy who regarded them as a mark of their elevated social status. In the eighteenth century, orangeries were usually free-standing and often designed in the prevailing classical style. The botanist Dr Richard Bradley had published a design for an orangery with a partially glazed roof in 1718, but generally eighteenth-century orangeries had solid roofs as well as piers that could be almost as wide as the windows. They were admired more for their elaborate architectural qualities than their horticultural function, but this was set to change in the first decades of the nineteenth century.

During this period, the increased interest in horticulture, along with developments in glass and iron manufacture, as well as methods of heating, created a different type of structure which came to be known more consistently as a conservatory. It began increasingly to be attached to the house in order to be used as a social space and became a sought-after appendage. The desire for this new fashion is aptly illustrated in a scene from Disraeli's 1837 novel *Henrietta Temple* in which the heroine's father says, 'I built a conservatory, to be sure. Henrietta could not do without a conservatory'; to which Ferdinand replies, 'Miss Temple is quite right, it is impossible to live without a conservatory.' [1]

Conservatories were first introduced by Humphry Repton in his designs for country estates, and were then advocated by John Loudon, who contributed more than anyone else to increasing their accessibility to households lower down the social scale. As Loudon commented in 1832, 'a green-house, which fifty years ago, was a luxury not often to be met with, is now become an appendage to every villa, and to many town residences' (Loudon, 1832, p. v). Loudon is a towering figure in the horticultural world of the late Georgian and early Victorian period. As so many of the smaller conservatories attached to villas and more modest houses have been lost, his designs and specifications – along with those of other figures like the architect and landscape designer

[1] This scene is quoted in Hix, 1974, p. 90.

John Papworth and the hothouse builder and surveyor George Tod – provide invaluable evidence of what is now a relatively rare building type.

This article concentrates on the type of conservatory that emerged during the late Georgian period. It touches briefly on the technical developments that led to their creation before focusing on how they began to be integrated within the house, their role as a social space and their association with the female members of the household. It explores the spatial and stylistic integration of conservatories within the house, and then focuses on their internal layout and treatment.

The definition of a 'conservatory'

John Evelyn is credited with being the first to use the term 'conservatory' in 1664, by which he meant a place for conserving delicate plants over the winter months. He employed the term 'greenhouse' in the same way, and this usage continued throughout the eighteenth century. By the early nineteenth century, the terms conservatory and greenhouse were still being used interchangeably by Repton but a distinction in their meaning was becoming apparent. The greenhouse came to denote the structure used for potting plants and over-wintering, whereas the conservatory was used to describe a structure, usually attached to the house, in which planted beds were growing permanently. They had glazed roofs as opposed to the solid roofs which orangeries invariably had. Conservatories were often treated architecturally to harmonise with the house, whereas greenhouses, which had a practical rather than a social function, were usually detached structures of more modest design.

In 1812, George Tod still used both terms without any apparent distinction when referring to his designs for horticultural structures that adjoined the house. A few years later Papworth stated that:

> The conservatory is distinguished from the greenhouse by the circumstances of its affording protection only to the plants; whereas the latter is used for rearing them, and it has become an apartment in which they are arranged for display, merely allowing space for walks or a promenade, and is frequently used as a breakfast or dining room (Papworth, 1818, p. 86).

By 1835 Loudon defined conservatories as 'plant-houses, in which the plants are grown in a bed or border without the use of pots. They are sometimes placed in the pleasure-ground along with the other hot-houses, but more

frequently attached to the mansion' (Loudon, 1835, p. 1013). His wife, the botanical writer Jane Loudon, added that by putting the plants in the free soil they are allowed to assume their natural shapes and habits of growth (Loudon, 1842). Conservatories therefore contained large or fine specimens whilst plants in greenhouses would be kept quite small and young by repeated propagation.

Technical developments

By the early nineteenth century, the popularity of exotic plants requiring shelter and warmth all year round stimulated experiments to find the most efficacious design for a greenhouse. One of the most significant developments was the invention of the glazed roof. Until the turn of the nineteenth century, the roofs of glasshouses had usually been covered in slate or other traditional roofing materials, but gardeners and botanists began to realise that imported exotics required year round protection and benefited from more overhead light. It is thought that greenhouses with fully glazed roofs may actually have been built as early as the 1790s, but one of the earliest surviving examples is at Chiselhampton House in Oxfordshire, which was built around 1800. The revolution in the design of glasshouses, which had hitherto taken the general form of a glazed shed or lean-to, is attributed to the horticulturist Sir George Mackenzie in 1815. The form he proposed was one-fourth of a sphere, or a semi-dome, supported by a wall (*Transactions of the Horticultural Society of London*, 1818, Vol. II, p. 171). Loudon regarded this hemispherical shape as the perfect form. In 1816 he devised a wrought-iron glazing bar which could be curved in any direction without losing its strength, enabling Mackenzie's design to be constructed. He built the first curvilinear iron-framed glasshouse in his own garden at Bayswater House in London which he illustrated in *Sketches of Curvilinear Hothouses* (1818).

These new iron-framed conservatories were further improved by innovations in heating techniques. In the eighteenth century, glasshouses had been heated using stoves or coal-fired under-floor or wall flues, but these methods produced a dry heat as well as fumes which were often harmful to plants, and they required regular stoking. According to Loudon, the first application of steam to the heating of hot houses had been attempted in 1788, and by 1818 Papworth remarked that 'ingenious stoves and apparatus have been lately invented and used for the purpose of heating conservatories and green-houses by steam' (Papworth, 1818, p. 87). In 1826 the architect William Atkinson developed a successful system for heating conservatories

using hot water supplied through cast-iron piping. This meant that for the first time conservatories could be heated more evenly and with a more constant temperature, without any smoke or fumes.

The final major technical advancement to affect the design of conservatories occurred in the manufacture of glass. The widespread use of crown glass as a building material had hitherto been prohibited due to its cost and the restricted size of panes. Between 1746 and 1845 glass was taxed by weight so it was more cost-effective to produce thin sheets which were, as a consequence, too fragile to be made into large panes. The tax was halved in 1825 making glass more affordable. Then in 1832 the Chance Bros of Birmingham produced much larger sheets than had previously been achieved by using a new method of blowing cylinder glass. The sheets were thirty-six inches in length which was at least fourteen inches longer than was possible using crown glass.

The integration of the conservatory within the house

These technical developments allowed a new type of conservatory to be built which had greater levels of light and more efficiently regulated heat, making them more equipped to house permanent displays of plants and flowers. Conservatories thus became a more agreeable place in which to spend time and so they began to be positioned nearer to the house. This desire to integrate the conservatory into the living accommodation was a natural outcome of the late eighteenth-century impulse to achieve a closer relationship between the house and its landscape. The main reception rooms were generally at first-floor level in grander Georgian houses, but in the nineteenth century these began to be positioned on the ground floor which enabled easier access to the gardens and facilitated the introduction of an integrated conservatory.

The appearance of full-height casement windows in the 1780s, and the addition of balconies and verandas, further allowed the landscape to be experienced from the interior, blurring the distinction between inside and outside. Flower gardens, terraces and balustrades were positioned around the house so that ornamental plants could constantly be seen and experienced, rather than being placed some distance away from the residence. Repton was one of the key figures in encouraging this closer link between the house, garden and landscape, and throughout his career he produced many designs for conservatories and French windows (Musson, 2005, p. 172). Luscombe Castle in Devon, which he designed with John Nash in 1800, is one of the earliest examples of the incorporation of a conservatory into the social space

of the main house. It leads directly off the drawing room which consequently has views of the park not only from its own windows but also through the glass walls of the conservatory. It is Gothic in style and was fitted with removable windows so that it could be used as a veranda in warm weather.

Repton, in fact, often preferred the conservatory to be detached from the house, and placed in the flower garden instead. He objected to its integration on the basis of 'its want of conformity to the neighbouring mansion, since it is difficult to make the glass roof of a conservatory architectural, whether Grecian or Gothic'. Furthermore, he stated that 'such an appendage, however it may increase its interior comfort, will never add to the external ornament of a house of regular architecture.' He also objected to a conservatory being 'immediately attached to a room constantly inhabited' because 'the smell and damp from a large body of earth in the beds, or pots, is often more powerful than the fragrance of the plants; therefore [it] should always be separated from the house, by a lobby, or small anti-room' (Repton, 1805, in Nolan, 1907, p. 217). One of his favourite plans was to attach the conservatory to the house via a flower passage.

Despite his objections, Repton acknowledged that 'amongst the refinements of modern luxury may be reckoned that of attaching a green-house to some room in the mansion, a fashion with which I have ... often been required to comply' (ibid.). As at Luscombe Castle, he frequently designed the conservatory to be accessed directly from the drawing room or one of the other principal living rooms. Repton also encouraged the addition of a conservatory to existing houses, notably when they had an irregular Gothic plan, as this especially lent itself to an asymmetrical extension.

Largely through Repton's influence, the conservatory thus became a key room in the Regency era (Musson, 2005, p. 172). It was described by Papworth in 1818 as:

> an embellishment of the most agreeable kind to the garden and also to the mansion; for instead of being, as originally, in a removed situation, the conservatory is now placed in connexion with the house itself, with which it elegantly combines, and gives an apartment highly valuable from its beauty and cheerfulness (Papworth, 1818, p. 85).

With the improvements in glasshouse design, and Loudon's advocacy of the benefits of greenhouses and gardening generally, the desire for a conservatory began to filter down the social scale by the second decade of the nineteenth

century. As Loudon observed, though neither the conservatory nor flower-garden was essential to a suburban residence, 'they are yet additions which few persons, who can afford the expense will like to be without' (Loudon, 1838, p. 414). Encouraged by the contemporary press, which was replete with horticultural journals and magazines, treatises on garden layouts and designs, as well as plans for greenhouses of all descriptions, the middle-class householder received plentiful advice about how to build and look after their conservatory. Loudon in particular provided garden and greenhouse plans for houses with a relatively small amount of land, such as those he included for villa grounds from one perch to a hundred acres in *Hints on the Formation of Gardens and Pleasure Grounds* (1812).

Regrettably, very few of these early conservatories built by middle-class householders have survived, mainly due to the cost involved in their maintenance – an expense that usually only wealthier families could meet over succeeding generations. Contemporary publications such as those by Loudon, Papworth and Tod therefore provide an invaluable insight into the construction, design, layout and use of the more modest conservatories in the earlier part of the nineteenth century.

The appropriate location of conservatories

The new informality of social life

As conservatories were being increasingly added to existing houses and incorporated into new house plans, one of the key considerations was their most appropriate location. According to Loudon, in order for the conservatory to be truly enjoyed as a luxury it was essential for it to be attached to the house, the most desirable location being next to the breakfast parlour or library which was then the most important family sitting room. He asserted that:

> If it communicates by spacious glass doors, and the parlour is judiciously furnished with mirrors, and bulbous flowers in water-glasses, the effect will be greatly heightened, and growth, verdure, gay colours, and fragrance, blended with books, sofas, and all the accompaniments of social and polished life (Loudon, 1832, p. 6).

This type of arrangement was typical of the more informal manner of entertaining and socialising that had developed by the early nineteenth

Fig. 1. The conservatory at Shrubland Park, Suffolk, added by J.P. Gandy-Deering in 1831–1833. © Historic England Archive.

century. Instead of the rigid eighteenth-century conversation circle, social life in households was increasingly based on a more fluid arrangement in which family and guests conversed in groups, read books, or walked amidst the plants in the conservatory. For Loudon, the second-best situation for the conservatory was therefore where it could communicate with the drawing room, the air of which would be perfumed by the scent of the plants. The conservatory thus became an integral part of the physical and social space of late Georgian households. At Shrubland Park in Suffolk (1770–1772), after the remodelling in the early 1830s, the new conservatory opened into the boudoir and became the main living space in the house for a greater part of the year (Fig. 1).

The most advantageous positions for the conservatory

Contemporary gardeners and architects mostly agreed that the conservatory should be situated as close to the house as possible, although there was some difference of opinion. Charles McIntosh, in his 1838 *Greenhouse, Hot House and Stove*, stated that 'the most proper situation for the conservatory is either in the flower-garden, where it should be a detached structure, or adjoining to the mansion, of which it may be said to form a part'(McIntosh, 1838, p. 232). Despite the individual requirements in each case, it was thought that the best position for a conservatory was on the south side of the house, preferably on the south south-east, from which it would receive the most sunlight. This corresponded to the usual position of the breakfast room which thereby benefited from the morning sun and enticed the occupants to venture into the garden. It was also preferable for the plants, Loudon explained, as the morning sun 'dries up the damps generated during the night' and illuminates 'their foliage and flowers to the spectators in the living-room'. A conservatory with a west or even south-west aspect was not advisable as it required much more fuel to keep it heated (Loudon, 1832, p. 10).

In *A Treatise on Forming, Improving, and Managing Country Residences* (1806), Loudon provided the plan for a house with a large conservatory and vinery he had designed for a 'small place in the neighbourhood of London, where no prospect, or good external views, can be obtained from the windows' (Fig. 2). The conservatory was thus positioned to be accessed via the three principal living rooms: the library, drawing room and dining room, from which Loudon explains, 'agreeable perspectives through the conservatory may be obtained, even while sitting at table' (Loudon, 1806, p. 348). Furthermore, all the bedrooms on the south side of the house had windows coming down

to the floor and looking entirely into the conservatory. The conservatory was by these means completely integrated into the plan of the house, providing a room for entertainment as well as making up for the absence of views.

William Cobbett in *The English Gardener* (originally published in 1829) also argued that in order for a conservatory to be 'an agreeable thing' it should be very near the house. He saw it as a means of giving pleasure and, he wrote, 'for the rational amusement and occupation, of persons who would otherwise be employed in things irrational; if not mischievous.' If it were at a distance from the house, the inhabitants would invariably not make the journey to it in cold, wet weather, thereby precluding its beneficial effects. In Cobbett's view, it should therefore be erected next to the house, preferably on the south side, 'and a door into it, and a window, or windows looking into it, from any room of the house in which people frequently sit, makes the thing extremely beautiful and agreeable' (Cobbett, 1980, pp. 37–38). Loudon agreed, claiming that 'a green-house, however excellent and well managed, if it cannot be seen and entered without going into the open air, can never afford half its appropriate enjoyments during the winter season' (Loudon, 1832, p. 7).

Many published plans for suburban or country residences invariably had gardens surrounding the house and could thus incorporate a conservatory in the optimum location. The most suitable suburban residences for having a conservatory, Loudon observed, were those that were either detached or in pairs. If the house was small, the usual way of attaching a greenhouse or conservatory was by placing it against the gable end (Loudon, 1838, p. 110). In London, where gardens were smaller and more likely to adjoin only the rear of the property, greenhouses were sometimes placed behind the house on the tops of kitchens and other offices. As the architect and Professor of Perspective Richard Brown described in his later work *Domestic Architecture* (1841), just as in the country where conservatories were built on the ground floor next to the drawing room or breakfast room, so in London, where the drawing room was often on the first floor, they were placed on this level as well (Brown, 1841, p. 176).

The conservatory was thus, wherever possible, adjoined to the living rooms of the house, especially the drawing room. The publications of the period are full of plans in which this arrangement is found, mostly for ground-floor conservatories. Charles Middleton in *The Architect and Builder's Miscellany* (1812) provided a plan for a Palladian-inspired house in which one of the pavilions contains a conservatory opening into both the drawing room and the music room. In the majority of plans included in Tod's *Plans, Elevations*

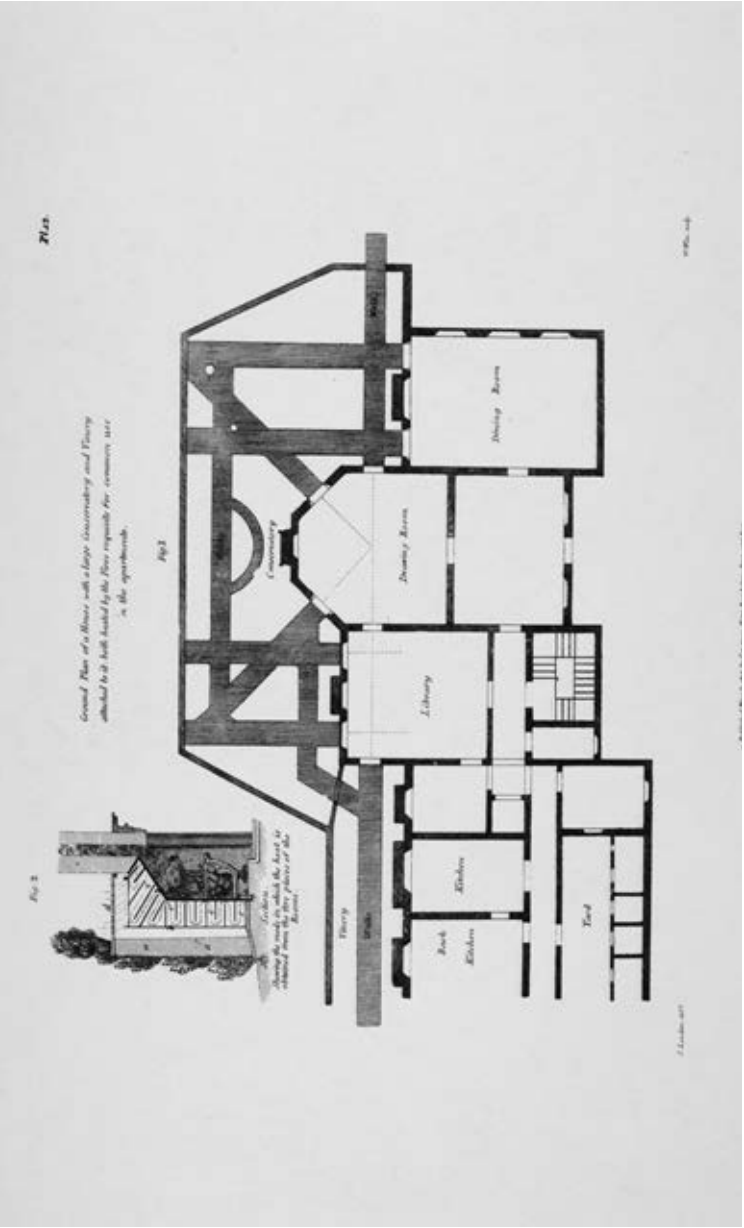

Fig. 2. Plan of a house from Loudon's *A Treatise on Forming, Improving, and Managing Country Residences* (1806), Plate XII, figs 1 & 2. © Historic England Archive.

and Sections (1807), the drawing room opens into the conservatory through French windows. Loudon advised that in large houses the conservatory should be separated from the drawing room by glass doors or windows opening down to the floor 'so as to give the idea of the drawing room and conservatory forming but one room' (Loudon, 1838, p. 111).

The conservatory as the female domain

In the early nineteenth-century house, certain rooms had gender associations: the library and study were traditionally seen as the male domain, whilst the drawing room was the natural environment of ladies. The typical attachment of the conservatory to the drawing room therefore brought the conservatory within the female domain and became particularly associated with women. An article in *The Gardener's Magazine* (April 1826) about a conservatory recently added to The Grange, Hampshire, noted that 'into this spacious apartment of perpetual spring, are directed the windows of those apartments dedicated to the ladies' (p. 107). The connection between the conservatory and the female inhabitants of the house also developed from the idea, encouraged by Loudon, that 'women were naturally indoor people and men outdoor' (Davidoff & Hall, 1991, p. 190). In *The Green-House Companion* (1832), Loudon remarked that:

> A green-house is in a peculiar degree the care of the female part of the family, and forms an interesting scene of recreation to a mother and her daughters, at a season of the year when there is but little inducement to walk in the kitchen-garden, and nothing to do in the parterre or the shrubbery (p. 2).

At Wrest Park in Bedfordshire (built 1834–1839), which was designed by the owner Thomas Philip, 2nd Earl de Grey, the conservatory opens directly out of the Countess's sitting room, the doors of which are aligned so that she could see the Italian Garden through the conservatory and to the kitchen garden beyond (Fig. 3).

The conservatory, furthermore, was used primarily to display flowers, and women were regarded as having by nature an inherently stronger response to, and love of, flowers than men. This association had been well established before the nineteenth century. Dr John Lindley, a Professor of Botany at the University of London, published *Ladies' Botany: a Familiar Introduction to the Study of the Natural System of Botany* in 1834, partly because he was:

> anxious that the endless variety of beautiful objects which the Vegetable world so prodigally strews before our path should, with those who from their habits of life and gentler feelings are the most sensible to the charms of nature, become something beyond a vague sentiment of undefined admiration (Lindley, 1834, p. 2).

Lindley's *Ladies' Botany* was one of many books published specifically to instruct women in the art of gardening and the study of botany, a market that was dominated by Jane Loudon. In *Instructions in Gardening for Ladies* (1840) she affirmed that 'whatever doubts may be entertained as to the practicability of a lady attending to the culture of culinary vegetables and fruit-trees, none can exist respecting her management of the flower-garden, as that is pre-eminently a woman's department.' The reason she gave for this, however, is nothing to do with the supposed notion of women's superior sensitivity to nature, but because 'the culture of flowers implies the lightest possible kind of garden labour' (Loudon, 1840, p. 244).

The style of conservatories

So whilst the most suitable location of the conservatory was widely agreed upon, the question of its stylistic integration also had to be addressed, whether it was designed as an integral part of a new house or attached to an existing one. Prior to the invention of the curved iron glazing bar in 1816, the roofs of greenhouses and conservatories were invariably of a lean-to design. Loudon regarded such structures as fit only to be positioned in the kitchen garden and unsuitable for conservatories which should be attached to the house because, he explained, they provided 'the gaiety and beauty of spring and summer amidst the frigid scenes of winter'. He acknowledged the attempt to render conservatories more stylistically pleasing by disguising their 'shed-like appearance' with stone piers and parapet walls, but found that this invariably led to loss of light to the detriment of the plants (Loudon, 1818, p. 1). A distinction thus arose between what Loudon termed 'architectural' and 'not architectural conservatories' (Loudon, 2000, pp. 979–980).

The discrepancy between what was suitable from a horticultural perspective and what was architecturally desirable was not easily resolved. The curvilinear iron-framed structures advocated by Loudon in 1818 were not generally regarded, certainly at this early stage, as being aesthetically compatible with masonry structures. There are some examples of curvilinear

Fig. 3. The conservatory built 1834–1839 at Wrest Park in Bedfordshire. Source: Historic England.

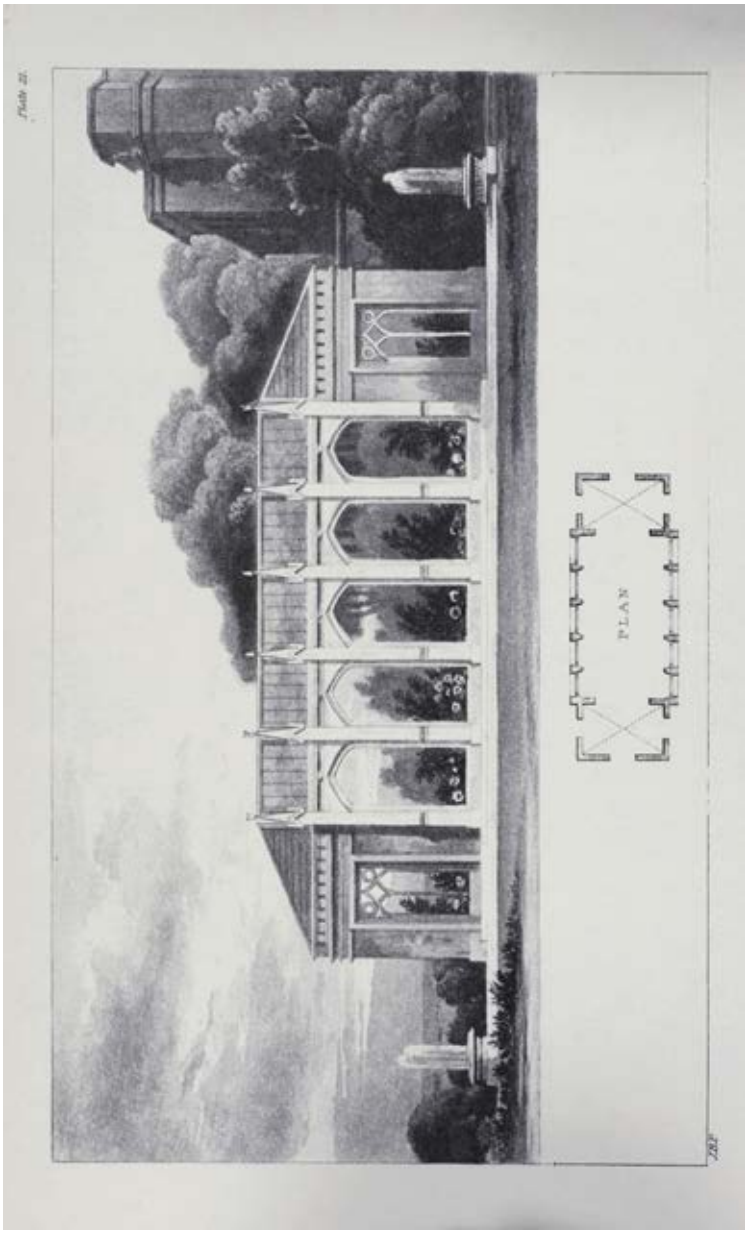

Fig. 4. Papworth's plan and elevation for a Gothic conservatory in *Rural Residences* (1818), Plate XXI. Source: Historic England.

conservatories attached to houses such as the early nineteenth-century half-domed conservatory on the front of Brooklands in Sawston (Cambridgeshire), but they are more often found as detached structures in gardens. Loudon believed that an edifice cannot be 'in correct taste, whose architecture is at variance with its use, which as it is rendered more beautiful, becomes less useful' (Loudon, 1818, p. 1).

Papworth (1818), for one, disagreed about the aesthetic merits of the 'new forms' of conservatories. He believed that:

> Great judgement is required to connect it with the building so as to display its proposed forms without injury to those of the mansion itself; from which, indeed, it ought to receive its character, and of which it should assume to be a part; for, however agreeable variety may be, incongruity is always fatal to its charms with every well cultivated and tasteful mind.

His own designs always derived their character from the house, as is illustrated by this Gothic conservatory which he thought suited to 'buildings of the same or of the castle character' (Papworth, 1818, p. 86; see Fig. 4). Although Decimus Burton initially showed interest in the curvilinear form, he too came to favour architectural conservatories that combined an elegant masonry structure supporting large window openings, with wood or iron-framed glass roofs.

Late eighteenth- and early nineteenth-century architecture was distinguished by an exuberant variety of historical styles which were duly applied to conservatories with equal fervour. As Loudon pointed out:

> Where a house is characterised by some particular style of architecture, it is easy to impress that style on the green-house. The form of the heads of the doors and windows, peculiar to the different orders of Gothic architecture, can readily be imitated in the front sashes and doors of a green-house; and in the case of Grecian architecture, the mouldings of any orders are readily applied to the styles, rails, and bars, and to the standards and other posts: and even columns may be introduced in very considerable erections (Loudon, 1832, p. 13).

Papworth (1818) presents numerous styles for villas with attached conservatories from Gothic to Classical, and Brown's plans and elevations in *Domestic Architecture* (1841) also perfectly encapsulate the freedom

with which architects plundered the past to offer their clients all manner of dwellings. It was possible to live in a Tudor mansion house with a conservatory embellished with a continuous drip mould over the tall glazed openings; or a villa in the Florentine style with a conservatory in the form of a pavilion which had a pedimented tripartite window and moulded apron.

One of the most striking conservatories in the Tudor style is at Orton Hall, Peterborough, which was extensively rebuilt in 1835 (Fig. 5). It has a pierced crenellated parapet and the bays are divided by buttresses surmounted by tall finials. The six Tudor arched windows are crisscrossed with bands of coloured glass bearing the family motto 'Let Curzon hold what Curzon held'. The interior is no less elaborate with its hammerbeam roof which has crenelated collar beams, elaborate pendants at the bottom end of the hammer posts, and arched tie beams resting on corbels in the forms of gargoyles. Houses in the classical style could equally well accommodate a conservatory. In the early 1820s William Atkinson designed one in the style of a Greek temple at The Deepdene in Surrey; and Gandy-Deering's design at Shrubland Park is in the Italianate style, complete with balustraded parapet.

Interiors

Much thought was given to the internal treatment of conservatories to render them as attractive and engaging as possible. In terms of decoration, Cushing insisted that they should:

> always be finished off in a tasteful manner, suitable to the purpose, and a good provision made for the various climbing plants, of which there are a considerable variety that constitute a principal share in ornamenting these departments, by being trained on the piers, or wires, hanging in fanciful festoonery along the roof of the house (Cushing, 1814, pp. 135, 141).

He encouraged the practice of placing pots or urns in every part of the conservatory, on shelves or benches that may be over the flues and on any window stools. These, he asserted, 'if judiciously filled, with handsome growing and flowering plants, will add very materially in elegance to the contour of the whole group'. Stands were erected to display plants to the best advantage, and in some instances stages were made to revolve in order to present them in their varying aspects. Paths and walkways were laid out around the planted beds, sometimes paved in tiles or stone with iron grilles to admit the heated air, or otherwise covered with gravel or turf – if the former, it was advised that

Fig. 5. The Tudoresque conservatory built in 1835 at Orton Hall in Peterborough. Photo: Melissa Thompson. Published with the permission of Orton Hall.

they should be kept smooth and firm from frequent rolling, and kept dry by the positioning of the flues and hot-water pipes directly underneath.

A more elaborate internal treatment often included fountains, arbours with seats, aviaries, and fishponds. Repton's plan for the conservatory at Harewood House has a central section with two large beds and flowering shrubs with an apsidal projection for water or a fountain. A description of the Gothic style conservatory at Alton Towers in 1841 mentions that it was richly ornamented with sculptures, fountains, vases, china jars and cages of singing birds, altogether creating a most splendid space in which to promenade or idle away the hours. Conservatories were further embellished through the use of coloured or stained glass. A contemporary account of 'a very splendid and imposing conservatory attached to a house on the road to Kensington' describes it as having stained and painted landscapes on the glass which produced 'a most brilliant and imposing effect' when the sun shone through (Brown, 1841, p. 176).

Lybbe Powys' account of her visit in 1796 to Mr Williams' new house, called Temple, near Marlow in Berkshire, shows the degree of opulence and enchantment that conservatories could reach. She describes the house as:

> certainly a very good one, but fitted up and furnish'd in so odd and superb a style, that one cannot help fancying oneself in one of those palaces mention'd in the Arabian Nights' Entertainment … [A]t the farther end of a most magnificent greenhouse is an aviary full of all kinds of birds, flying loose in a large octagon of gilt wire, in which is a fountain in the centre, and in the evening 'tis illuminated by wax-lights, while the water falls down some rock-work in the form of a cascade. This has a pretty effect, but seems to alarm its beautiful inhabitants, and must be cold for them, I should imagine … We came away amazingly pleased with having seen so extraordinary a place as Temple must be justly esteem'd (Climenson, 1899, pp. 2888–2889).

Whilst the majority of conservatories would have been considerably more modest in design and overall effect, this description aptly illustrates their appeal, which endured well beyond the Georgian and Regency period.

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Biography

Dr Melissa Thompson has been a Listing Adviser for Historic England since 2010, having previously worked in historic buildings research, and is co-author of *Georgian Conservatories: History, Design and Conservation* (2019, Historic England Publishing).

The floral world of the Victorian conservatory

Brent Elliott
c/o The Lindley Library, The Royal Horticultural Society, London

'There is no ornament of a flower-garden more appropriate than a conservatory, or a greenhouse'[1], said Humphry Repton in his *Observations*, 'where the flower-garden is not too far from the house'. Repton was responding to client demand, with which 'I have been so often required to comply' (Repton, 1803, p. 103).

As we can see from the Repton quotation, 'conservatory' was already being used by the end of the eighteenth century to mean a glazed structure for housing a collection of ornamental plants. John Claudius Loudon, followed by Joseph Paxton, attempted in the 1830s to restrict 'conservatory' to houses in which plants were placed in beds, while houses whose plants were kept in pots and tubs should be called 'greenhouses' (Loudon, 1824, 1, pp. 28, 237; Paxton, 1845; Fish, 1850). Few followed their example. When the Palm House at Kew was opened in the 1840s, the palms were planted in tubs; it was only in 1860 that they began to be placed in beds, to reduce their height; no one proposed that it should now be called a conservatory instead of a greenhouse (or stove).

Infrastructure

Loudon, in 1824, put the matter succinctly – a greenhouse 'is entirely a work of art: the plants inclosed [*sic*] are in the most artificial situation in which they can be placed, and require constant and unremitting attention to counteract the tendency of that artificial state to destroy them' (Loudon, 1824, 1, p. 13). So underlying all questions of cultivation were certain matters of infrastructure

[1] The vocabulary of glass buildings was as confused in previous centuries as it is today. 'Conservatory' is the oldest term, but originally meant an ice-house or other refrigerated store; by John Evelyn's time it was being treated as a synonym for 'greenhouse'. 'Orangery' can be found in Evelyn, and denoted a building used to house citrus trees, the seventeenth century's principal horticultural fashion requiring protected cultivation; once pineapples came to rival citrus fruits, the use of the term declined. By the end of the century 'hot-house' had appeared, initially more or less synonymous with the foregoing; 'stove' dates from the mid-eighteenth century. 'Greenhouse', with or without a hyphen, was more or less synonymous with 'orangery' until kitchen gardens began to boast glass structures too large to be called frames. 'Glass-house' is a coinage of the age of Loudon.

that developed steadily over the course of the century. There is space here for only the barest of abstracts.

Architecture. Early conservatories were built of wood, augmented in the most ambitious examples by stone or brick façades for stylistic effect – basically standard single-storey buildings with the maximum window provision. By the standards of the later nineteenth century, they were dark places. In 1815, Sir George McKenzie proposed: 'Make the surface of your green-house roof parallel to the vaulted surface of the heavens, or to the plane of the sun's orbit' (McKenzie, 1817). Loudon responded by inventing a wrought-iron glazing bar, that could be produced in any degree of curvature required.[2]

But Loudon had earlier proposed a ridge-and-furrow roof, angled to admit both morning and afternoon light, and Paxton promoted this as more functional than the curvilinear iron house: lighting adequate if not perfect, but capable of being made of wood, and therefore built and maintained by the estate staff without requiring specialist ironfounders. Also, wood did not expand and contract as rapidly as iron with changes in temperature. Robert Fish, the head gardener at Putteridgebury, Hertfordshire, said, 'we have gone out on a cold, frosty night ... and have heard the panes crack and chip in dismal chorus, when those under similar circumstances on a wood roof never made so much as a chip', concluding, 'Good, sound *deal*, say we, for all dimensions and kinds of glass roofing' (Fish, 1854). Paxton's success in designing the Crystal Palace stimulated a large-scale return to wooden construction from the 1850s (Errington, 1854). It is safe to say that after 1860, the perceived benefit of iron was its capacity to create fine decorative detail, and in the 1870s it became possible to produce curvilinear sections in wood, thanks to Lascelles' process of bending wood by steam (B., 1874).

Glass. Early nineteenth-century glasshouses had small panes, and therefore an abundance of glazing bars which reduced the amount of light that reached the plants. It was possible to produce glass in large sheets, but none of the early processes could produce glass that was free from bubbles and other

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[2] The first free-standing iron and glass conservatory was erected at Bretton Hall, Yorkshire, in 1827, by Bailey of Holborn, with Loudon advising: 'there were no rafters or principal ribs for strengthening the roof besides the common wrought-iron sash-bar ... This caused some anxiety, for when the ironwork was put up, before it was glazed, the slightest wind put the whole of it in motion from the base to the summit ... As soon as the glass was put in, however, it was found to become perfectly firm and strong[.]' (Loudon, 1829).

Fig. 1. The conservatory at Grimston Park with plants arranged in beds (*Gardeners' Chronicle*, 1880). RHS, Lindley Collections.

imperfections. It was generally feared that bubbles could act as burning-glasses, focusing light on the leaves below and damaging them. In the 1840s, especially with the patent of James Hartley in Sunderland, sheet glass of a uniform consistency, without bubbles, became commercially available. The 1850s saw a wave of glasshouse upgrading throughout the country, with the small panes being replaced by large sheets.

Other refinements in the use of glass were the use of putty, first mentioned by George Tod (1807, p. 7), and the introduction of double glazing. Donald Beaton (1861) later claimed that double glazing had been familiar in Scotland in the 1820s, but it was not until the 1850s that it began to be used in England, and not until the 1880s that it was recommended in standard literature (Wood, 1881, pp. 15–16). At intervals throughout the century there were

Fig. 2. The greenhouse at Woolverstone Hall where plants are displayed in pots (*Gardeners' Chronicle*, 1874). RHS Lindley Collections.

experiments to see whether different-coloured glass would be beneficial for plants, and such prestigious buildings as the Palm and Temperate Houses at Kew were initially glazed with green-tinted glass; but the results were generally regarded as unsatisfactory, and the houses at Kew were reglazed in colourless glass after a few decades.

In all the excitement over increasing the amount of light admitted to greenhouses, the problems of excessive illumination could be easily forgotten. The whitewashing of utility glass had a long tradition, but owners of expensive conservatories resisted it, preferring more easily removable methods, like tiffany sheets or systems of blinds. As Frederick Boyle said, on the need to shade tropical orchids, 'Those who denounce shading forget that the Dendrobe on a tree-top has no glass above its head' (Boyle, 1902, p. 7).

Heating. Utility greenhouses for the kitchen garden had long been heated by the use of pits of dung, bark, or tannin, and this custom carried on, especially in decorative glasshouses which were still basically for fruit growing (pineapple houses and the like). For exotic plant collections, braziers were an alternative, at the risk of filling the houses with smoke. The development of greenhouse heating has been thoroughly covered by Van den Muijzenberg (1980, pp. 144–217), so I can be very brief here. The eighteenth century saw the development of flue systems running from external furnaces, thus reducing indoor smoke and somewhat equalising internal temperatures. Improvements in technology tended to be published long before they were implemented on a wide scale; so we find that the first experiments in heating by steam were made in the 1780s, but it was not until the 1810s that it became widespread. Similarly, the use of hot-water pipes was experimented with from the beginning of the century, but did not become widespread until the 1820s. By the time the Palm House at Kew was built, the use of hot-water pipes made it possible to maintain a temperature of 80°F, as well as to carry the smoke from the boilers to the chimney, disguised as an Italian campanile, on the other side of the lake.

Ventilation. In the days of braziers, it was important to allow an outlet for the smoke. All early ventilation was operated by hand, until in 1824 John Williams invented a self-acting ventilator (Williams, 1824). But one gets the impression that once interior smoke ceased to be a problem, the role of ventilation was downgraded. Robert Fish argued that 'too much importance had been attached ... to giving air' (Anon., 1838). By the 1850s it had returned as an issue, and it was agreed that it had not been well understood by the previous generation: 'many of the really magnificent structures, especially of iron, were defective in this particular' (Anon., 1855).

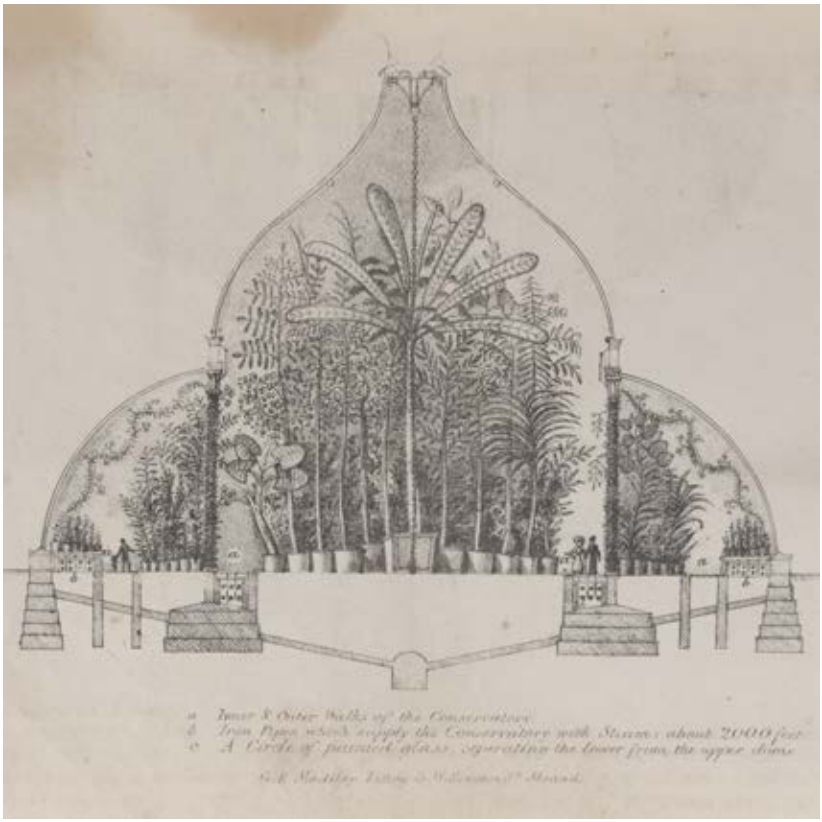

Fig. 3. Bretton Hall cross-section, from an 1832 sale catalogue *Bretton Hall, in the West Riding of Yorkshire*. RHS Lindley Collections.

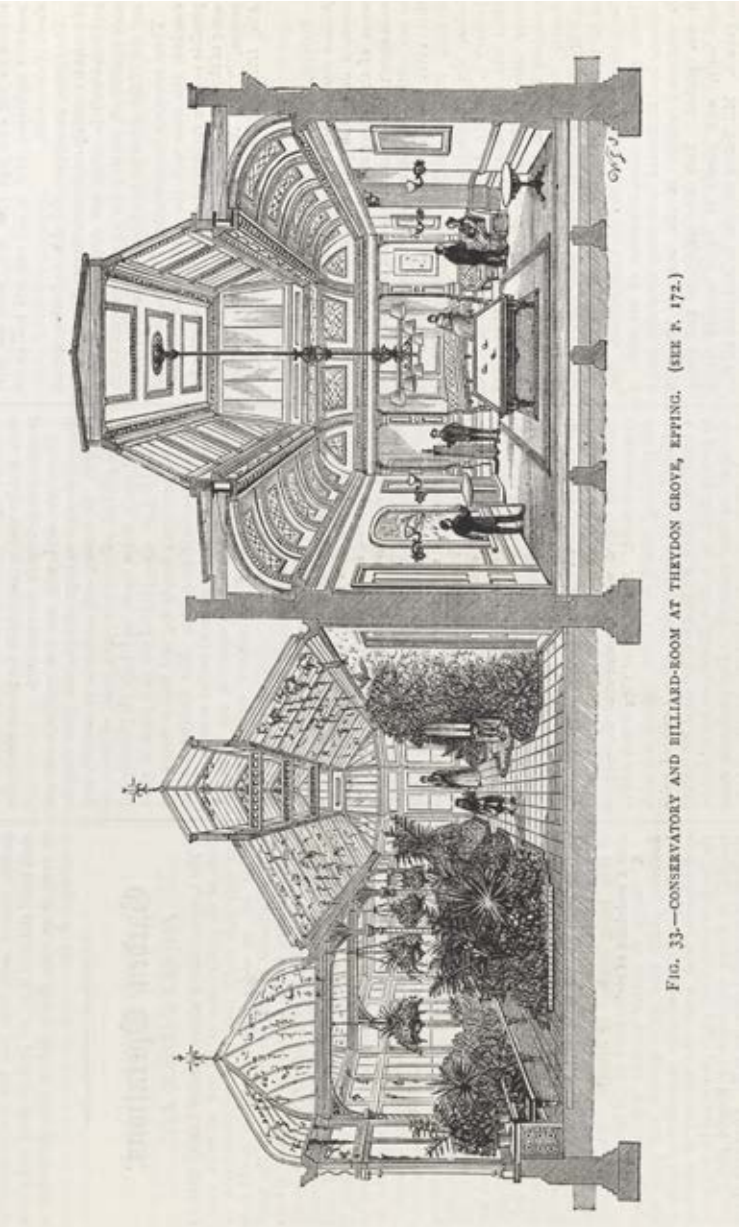

Fig. 4. Conservatory and billiard room – *Gardeners' Chronicle*, 1880. RHS Lindley Collections.

Fig. 5. Conservatory with roof raised, from Papworth, ***Specimens of Ornamental Gardening***, 1823. RHS Lindley Collections.

At the beginning of the 1850s, Nathaniel Bagshaw Ward used his celebrity as the inventor of the Wardian case to promote a new type of glasshouse which he claimed was an 'enlarged Wardian-case', in which 'air is always undisturbed, enabling the plants to bear without injury very varying degrees of temperature' (M., 1851). John Lindley used his leaders in the *Gardeners' Chronicle* to denounce Ward's claims as fraudulent: 'We have even known attempts made by speculative gardeners to convert their conservatories into WARDIAN cases upon a gigantic scale'; ''Wardian,' properly so called, is a CLOSE box with glass sides ... when it is opened and shut from day to day, it has no more right to the name than a common greenhouse' (Lindley, 1854; Lindley, 1855).

Another reason for ventilation was the use of tobacco as a standard insecticide for fumigating glasshouses, after John Read's invention of a handy fumigator (Read, 1824). In 1880 the *Gardeners' Chronicle* illustrated a conservatory by James Weeks at Theydon Bois, placed adjacent to a billiard room which, as a naturally tobacco-filled environment, provided a buffer zone between the conservatory and the rest of the house (Anon., 1880).

Watering. In early conservatories there was no alternative to hand-watering, apart from opening the rooflights or raising the entire roof when it rained (Papworth, 1823, pp. 91–93 and plate 17). But in 1818 the great nurseryman George Loddiges announced his development of a system of perforated pipes to provide the equivalent of rain inside a glasshouse (Sabine, 1818).

Remember that these developments were taking place all through the period under discussion. It should also be noted that not all conservatories were upgraded as new technology became available, and that many architects ignored as irrelevant the claims of gardeners. Matthew Digby Wyatt's 1860s glasshouse at Castle Ashby, complained the *Gardeners' Chronicle*,

> is an architect's conservatory, and our readers will know what that means. It is a place of handsome proportions, good workmanship, and an ornament to the garden; but the gardener abominates it, for do not his best plants lose their leaves and lower branches, and become attenuated objects of no decorative value, often readily falling a prey to insect enemies? (Anon., 1889).

Planting trends, 1820s–1850s

Loudon, in the heat of his excitement over the possibilities opened up by the wrought-iron glazing bar, envisaged the day 'when such artificial climates will not

only be stocked with appropriate birds, fishes and harmless animals, but with examples of the human species from the different countries imitated, habited in their particular costumes and who may serve as gardeners or curators of the different productions' (Loudon, 1817, p. 49).[3] But by the time he published his *Green-house Manual* in 1824, he appeared to have been disillusioned:

> [W]ithin the last fifty years the accession to our stock of exotics has been so great, that gardeners are quite bewildered among them, and the nurserymen at present, in their recommendation of plants, act as if every purchaser were a botanist. This is the reason why we see so very few greenhouses that present a gay assemblage of luxuriant verdure and blossoms: on the contrary, they are generally filled with sickly naked plants in peat soil, with hard names, which one-half of people of taste and fashion, and nine-tenths of mankind in general, care nothing about (Loudon, 1824, I, pp. 36–37).

'In short', he concluded, 'oranges, lemons, camellias, myrtles, banksias, proteas, acacias, melaleucas, and a few other Cape and Botany Bay plants, are all that can with propriety be admitted in a small conservatory' (Loudon, 1824, I, p. 31). This chastened list is not greatly different from what was being grown two decades earlier in Repton's time.[4]

How were plants arranged in the conservatory in the first quarter of the century? Such manuals as exist were concerned only to list or give instructions for cultivation. However, we have one interesting testimony from an anonymous mid-century writer (known simply as 'Tassel') looking back on the old days:

> Plant-growing at that period [1820] was a very different affair from what it is now; specimens, such as we see in the present day, were never thought of then, for who at that time would have given space to a plant where a dozen might have stood? To arrange the plants on the stage of a large greenhouse was no easy task. In the lean-to houses, vegetation necessarily inclined towards the light; the plants on the back of the stage

[3] No one else contemplated such a range of glasshouse curiosities: perhaps the Victorians regarded his proposals as too Georgian.

[4] See the list of plants in Table 1, drawn from Henrietta Maria Moriarty's *Fifty Plates of Green-house Plants* (1807).

> were tall and single-stemmed, crowded, and so placed that an unbroken bank of foliage might face the spectator from the front path, for flowers were indeed few and far between; perhaps an Epacris, a Protea, an Acacia or Mimosa, a [Cape] Heath or a Corraea might diversify the view with an occasional blossom. But, nevertheless, when the plants were judiciously arranged, this bank of foliage alone had a very pleasing effect, for so closely were the plants packed together, that little unsightly was to be seen. A great revolution in plant-growing, however, shortly afterwards took place ('Tassel', 1852).

'Tassel' attributed the change to the introduction of *Azalea indica* (*Rhododendron indicum*), 'well adapted for floral display'.

The genera that 'Tassel' named individually were either Australian or South African (though *Acacia* at that time included plants with a worldwide distribution). Other conservatory favourites from the same areas included banksias, dryandras, melaleucas, pelargoniums, and Cape bulbs like *Tritonia*. Cape heaths were the first category of ornamental plant to become the object of a programme of deliberate hybridisation. Rollisson's nursery in Tooting started breeding them in the 1790s, and by 1826 had produced 285 cultivars (Rollisson, 1826); Henry C. Andrews published two works on Cape heaths at the beginning of the nineteenth century, illustrating in all nearly 600 species and varieties. From the 1850s these plants began to disappear from the lists. By the 1870s, the number of Cape heath varieties in commerce had halved, and Benjamin S. Williams was puzzled why banksias had suddenly disappeared from cultivation.

Part of the reason was probably the change in the greenhouse environment. The hot dry atmosphere of the early conservatory, heated by braziers or flues, was ideal for many 'Cape and Botany Bay plants', but through the second quarter of the century changes in heating technology were steadily increasing the humidity of the glasshouse interior (Elliott, 2009). Commentators in the later nineteenth century wondered why banksias and dryandras were no longer being grown; even Cape heaths showed a steady decrease in availability from the 1860s on. The changing climate inside the greenhouse must be one factor in the decline.

Another change in planting during the second quarter of the century was the result of climate change – the increasing warmth of the climate after the prolonged cold snap of the 1810s. Plants like camellias and rhododendrons, once pampered under glass, began to emerge into the open air as experiments

Table 1. Greenhouse plants from Henrietta Maria Moriarty, *Fifty Plates of Greenhouse Plants* (1807). Botanical names have been updated.

Acacia verticillata	*Glandularia canadensis*
Agapanthus africanus	*Hippeastrum puniceum*
Aloe variegata	*Ipomoea cairica*
Anagallis monelli	*Ixia viridiflora*
Aristaea spiralis	*Jatropha integerrima*
Baptisia australis	*Lilium philadelphicum*
Buddleja globosa	*Lobelia coronopifolia*
Calla palustris	*Magnolia liliiflora*
Camellia japonica	*Malvaviscus arboreus*
Canna indica	*Maurandya scandens*
Capparis spinosa	*Monsonia speciosa*
Chironia decussata	*Nymania capensis*
Chrysanthemum indicum	*Pelargonium peltatum*
Convolvulus althaeoides	*Phlox stolonifera*
Coronilla valentina subsp. *glauca*	*Protea cordata*
Crassula coccinea	*Protea lepidocarpodendron*
Cyclamen persicum	*Punica granatum* cultivars.
Dais cotinifolia	*Rafnia triflora*
Daphne sericea	*Salvia formosa*
Disocactus flagelliformis	*Silene ornata*
Erica retorta	*Sophora tetraptera*
Fuchsia coccinea	*Sparmannia africana*
Gazania rigens	*Sutherlandia frutescens*
Geissorhiza imbricata subsp. *bicolor*	*Tritonia crocata*
Gladiolus carneus	*Wachendorfia paniculata*

and published records of frost tolerance persuaded gardeners to try them outdoors.

After Cape heaths, the next genera to become the objects of competitive cross-breeding were passionflowers, followed by tropical and subtropical *Liliaceae*, especially *Amaryllis* (including *Hippeastrum*) and *Crinum*. Mrs Bury's *Selection of Hexandrian Plants* (1831–1834) depicted fifty of these, including hybrids bred in the conservatories of Liverpool. This is an indication of the increasing trend towards growing plants from the more humid tropics, which reached its culmination at Chatsworth and the Palm House at Kew in the 1840s. Competition to introduce exotic plants animated private landowners as well as botanic gardens. The rivalry of Kew, Chatsworth, and Louisa Lawrence of Ealing Park provides a splendid anecdote. When Paxton's protegé John Gibson returned from his Indian expedition with a specimen of *Amherstia nobilis* for Chatsworth, the Duke of Devonshire was flustered by seeing a nursery offering the species for sale. John Lindley investigated, and wrote to the Duke:

> No, no, no, there is no Amherstia in the King's Road. Your Grace was quite right in your opinion, the imposter is Brownea grandiceps.[5] Instead of deriving his origin from the temple garden of Buddha he has had no more dignified birthplace than the bush round a Demerara sugar plantation. I am so happy to be able to assure you that your Amherstia is as yet the only Amherstia in Europe (cited in Lemmon, 1968, p. 216).

The Chatsworth plant did not flower, however, and Louisa Lawrence celebrated her success by sending flowering spikes to Chatsworth and Kew.

As yet, only the wealthy could maintain conservatories, and only the wealthiest could subsidise plant collectors. But the most coveted exotics entered the nursery trade and became available to a wider clientele with enviable speed. Table 3 shows a comparison of three plant lists from the 1820s and 1830s. The lists from Loudon (1824) and Paxton (1837) are recommendations for their readers; the middle list, from M'Arthur (1826), is a list from an actual conservatory, at The Grange in Hampshire. At The Grange, the Baring family was able to afford the most expensive rarities and assemble a range of plants possibly unequalled at the time. But notice how many of

[5] How very unfair to *Brownea grandiceps*, which only a few years earlier had been the ornament of the age.

the Grange's rarities could be recommended by Paxton a decade later: an indication at least of how efficiently the nursery trade was distributing exotic introductions.

Let us look at three categories of plants and trace their fortunes during this period.

Cacti and succulents

Attempts at growing cacti and succulents go back to the early eighteenth century, stimulated by the introduction of South African succulents into the Netherlands. The only publication by Kew's first plant collector, Francis Masson, was on stapeliads, which at the beginning of the nineteenth century were coveted for their curious flowers, despite their fly-pollinated foul smell. These plants would have been ideal, one would think, for the dry atmosphere of the early conservatory.

Loudon, however, dismissed cacti as a suitable subject for conservatories – 'None whose tastes are not vitiated or singular, or who do not look solely with the eye of science' could really take an interest in them (Loudon, 1824, I, p. 102). His wife's *Companion to the Flower-Garden* treated succulents more generously, and even gave instructions on growing stapeliads without any more chastening comment than that they were 'very curious stove-plants' (Loudon, 1844, p. 282). Very few collections of succulents were written up in the gardening press, the most important being that of Wilson Saunders at his garden at Hillfield, near Reigate (Anon., 1872). The Edwardian period proved more tolerant, extending its interest to attempts to grow hardy cacti outdoors, and when a major collection assembled at Heaton Mersey by Charles Darrah was bequeathed to the City of Manchester, a new glasshouse was built in Alexandra Park to accommodate it. The catalogue contained 1350 entries, and it was claimed without contradiction that it was larger than the collection at Kew.[6]

Orchids

One of the most important private glasshouse collections at the beginning of the century was that of William Cattley of Barnet, and it contained several tropical orchids. John Lindley, illustrating important specimens from the collection in his *Collectanea Botanica*, named a new genus *Cattleya* in his

[6] Kew's collection was substantially enlarged in 1929 with the gift of Californian succulents from Mrs Sherman Hoyt's exhibit at the Chelsea Flower Show.

Fig. 6. Alexandra Park, Manchester – the Darrah collection of cacti and succulents. W. W. Pettigrew, *Handbook of the City Parks* (1929). RHS Lindley Collections.

patron's honour. But the cultivation of orchids languished so long as gardeners thought of them as parasitic; the concept of epiphytes was only widely understood in the 1830s. Meanwhile Sir Joseph Banks had made an important innovation in orchid growing, the hanging basket: 'light cylindrical wicker baskets or cages of suitable widths, ... the upper portion being left open that the plant may extend its growth in any direction through the intervals, and yet be kept steady in its station' (Ker Gawler, 1817). Joseph Paxton popularised Banks' device, and by the mid-1840s hanging baskets would denote the presence of epiphytic orchids in conservatories (Appleby, 1845).

By the mid-century, nurseries such as Loddiges, followed by Veitch and William Bull in the second half of the century, and wealthy private gardeners like James Bateman at Knypersley Hall, were sending collectors overseas to bring back new orchids. In the late 1850s, John Dominy at the Veitch nursery succeeded in breeding the first orchid hybrid, and by the 1870s orchid breeding was becoming the rich man's hobby (Elliott, 2010, pp. 14–23). The orchid house became a distinct genre of conservatory during the second half of the century.

Victoria

Possibly the greatest sensation of this age of collecting was the introduction of the Amazonian water lily, then called *Victoria regia*, and its successful flowering at Chatsworth. Kew promptly had Richard Turner design a Victoria House. Few private estates attempted the feat. The maintenance of vast tanks of water, which needed to be kept in gentle motion (because the Victoria was a river plant), defeated most. One which succeeded, for a while at least, was Cherkley Court in Surrey. Since Paxton had demonstrated the weight-bearing capacity of the leaves by standing his daughter on one, a demonstration conveyed to the public by the *Illustrated London News*, Cherkley Court also had to pose children on the leaves for the *Gardeners' Chronicle* to publish (Anon., 1885).

The temperate conservatory

The second quarter of the century was the great age of the tropical conservatory. The great collections were still mainly to be found in glasshouses that were detached from the house, substantial works of architecture that stood on their own in the landscape, and had teams of skilled gardeners maintaining them. However, all that began to change from about 1850. The abolition of the tax on glass, and of duties on wood and brick,

Fig. 7. The English-style conservatory. *Gardener's Magazine of Botany* vol. 3 (1851). RHS Lindley Collections.

along with the improvement in the quality of sheet glass, made it possible for conservatories to be built more readily by suburban villa dwellers, and eventually by the lower middle classes in their terraced houses. Yet building was not the only cost associated with managing a conservatory; fuel for heating was also a considerable expense. Fortunately for the middle classes, the 1850s offered some stunning examples of glasshouses devoted to temperate plants, which did not require such an investment in coal. Meanwhile on the great estates, it was now feasible to multiply the number of glasshouses, and devote them to specialist purposes. In 1872, at Trentham in Staffordshire, 'The usual fate of gardeners in large places has overtaken Mr. Stevens: I found him busy among bricks and mortar. To build new or repair or rebuild old houses is a sure and certain part of the duties of the modern gardener' (Fish, 1872, p. 540).

The decade began with Paxton's Great Exhibition Building in Hyde Park, and the bigger and better version he erected at Sydenham after the Exhibition closed – the Crystal Palace. A temperate planting scheme was better suited to a building whose doors were constantly opening and closing. While Chatsworth and the other great estates and botanic gardens continued to maintain their tropical houses, temperate collections became the dominant manner for the third quarter of the century, and manuals began to appear promoting cool greenhouses (e.g. F. W. Burbidge's *Cool Orchids, and How to Grow Them,* 1874).

There is little point in presenting lists of the plants available for use. Benjamin S. Williams, whose Victoria and Paradise Nurseries in Holloway specialised in greenhouse plants, published multiple editions of two books on *Choice Stove and Greenhouse Plants*, one on flowering, one on ornamental-leaved, from the end of the 1860s. These will give an idea of the available range – along with his own catalogues, which illustrate the range of specialist glasshouses that visitors to his nursery could examine (orchids, nepenthes, Cape heaths, ferns, etc.). Shirley Hibberd's *Amateur's Greenhouse and Conservatory* (1875 and later editions) will serve for the lower-budget collections, and the two editions of Thomas Baines' *Greenhouse and Stove Plants* (1885, 1894) will indicate the fashions of the later period.

The interior landscape

By the 1850s, the collection of pots and tubs had become the norm for English conservatories, and even those whose plants were arranged in beds were not organised to form a landscape. Those who thought the English should become more adventurous in their glasshouse aesthetics could point to examples in France (see Boitard, 1825, pp. 114–116, and plate 25), and the comparison was aired in the press:

> The reason why the English have preferred their homely way of arranging plants, has been the convenience of it. Their object has been high cultivation; to secure which it is desirable that every plant should be readily accessible and removable ... Where plants are arranged in masses, in earth, or attached to stems, in irregular groups, this is not so easy to accomplish (Lindley, 1850).

The English, concluded Lindley, 'have generally preferred utility to mere beauty', and to some degree this was true. As late as the 1870s, Thomas

Baines was arguing against interior landscaping, that 'it is impossible to regulate the blooming season with plants that cannot be moved' (Baines, 1872, p. 312). But the taste for pots and tubs could not be accounted for by utility alone; Robert Fish proposed in 1852 that plants could be arranged in beds by plunging, i.e. still in their pots, for ease of removal when required (Fish, 1852, p. 28), so Chatsworth-like effects were not beyond the command of the ordinary gardener. Aesthetic preferences are seldom dictated by utility alone.

The first significant attempt to turn the interior of a conservatory into a landscape was made in the 1840s, when John Dillwyn Llewellyn, at Penllergaer, designed a house for the cultivation of epiphytic orchids. He was inspired by Robert Schomburgk's account of the discovery of the orchid *Huntleya violacea* on an island amid the rapids of the Essequibo, in Demerara, 'where a humid cloud, the effects of the spray, always hovers around them' (Lindley, 1838, text for pl. 26). In order to represent this scene, he constructed a rockwork of three ledges of sandstone; a hot-water pipe poured a stream of heated water to splash on each ledge in turn, creating the required humid spray. The result resembled 'what one fancies them in their native forests' (Llewellyn, 1846). Of direct importance for the future was Llewellyn's system of clothing the rocks with an underlayer of greenery – seedling ferns and lycopods. The later popularity of the temperate *Selaginella* as a carpeting plant for rocks owed its origin to memories of Penllergaer. Take as a typical example this description of the conservatory at Sundridge Park in Kent: 'The doorways are fringed with masses of virgin cork, over which Lygodiums, Ficus stipulata, fresh green Selaginellas, Begonias, and bright-veined Eranthemums ramble in rich profusion' (Anon., 1874).

The other well-publicised attempt at replicating exotic scenery in a British glasshouse before the 1860s was that of Nathaniel Bagshaw Ward, who claimed that the 'object I had in view ... was to give a representation (in miniature of course) of a tropical forest, in which the plants were to be seen growing in something like a state of nature' (M., 1851).

The aesthetic of the interior landscape was more heavily influenced by the cult of foliage, beginning with the fern craze, which affected the garden outdoors and in.[7] Ferns, filmy ferns and tree ferns such as *Dicksonia* and *Cyathea,* became staples of glasshouse cultivation. As in the open air,

[7] Between 1854 and 1871, eleven colour-illustrated books on ferns were published in Britain (see Table 2).

Fig. 8. Nathaniel Bagshaw Ward's conservatory – *Gardener's Magazine of Botany*, 1851. RHS Lindley Collections.

ferns were grown on rocks, and this meant constructing rockeries in the conservatory. In 1861, George Abbey published plans for an extensive greenhouse rockwork, consisting of 'massive fragments of freestone rock that have been exposed to the weather for a considerable length of time', especially if already mossy, or covered with seedling ferns (Abbey, 1861). By the middle of the decade, even smaller-scale middle-class conservatories were boasting ornamental rockworks, specifically for the growing of ferns (see for an example Hibberd, 1866). The firm of James Pulham, specialists in the construction of rock gardens in artificial stone, began during the 1860s to produce rocky screens for greenhouses in their characteristic 'Pulhamite' stone, a surviving example being their 1870 refurbishment of a glazed grotto

Table 2. **Colour-illustrated books on ferns published in England, 1854–1871.**

Sir William Jackson Hooker	*A Century of Ferns*, 1854
Charles Johnson & Sowerby	*The Ferns of Great Britain*, 1855
Anne Pratt	*The Ferns of Great Britain*, 1855 [originally published as part of *The Flowering Plants and Ferns of Great Britain*]
E.J. Lowe	*Ferns British and Exotic*, 1856–1860
Sir William Jackson Hooker	*Filices exoticae*, 1857–1859
Sir William Jackson Hooker	*The British Ferns*, 1861
Thomas Moore	*The Ferns of Great Britain and Ireland*, 1859
Thomas Moore	*The Nature-printed British Ferns*, 1859
Margaret Plues	*British Ferns*, 1866
E.J. Lowe	*Our Native Ferns*, 1867–1869
E.J. Lowe	*Natural History of New and Rare Ferns*, 1871

at Old Warden (now the Swiss Garden) in Bedfordshire. By the mid-1870s, we can find such an elaborate development as this:

> The house is divided into a series of bays by suitable banks, arches and abrupt rockeries that reach to the roof, the walks passing round these and opening again into roomy bays that are richly dressed with waterfalls and fountains. The visitor is completely deceived as to the extent and form of the structure … The roof, which is for the most part a regular span, is in three places varied, so that in the centre of each length we have roomy bays with ridge-and-furrow roof … At each of the entrances is a quiet bay … We then proceed through a narrow way arched over and lighted by perforations in the arches with yellow glass, and presently come into a romantic bay covered with green glass. The effect is startling, and when the young people behold how ghastly they look, the fun justifies the fancy (Harland, 1876).

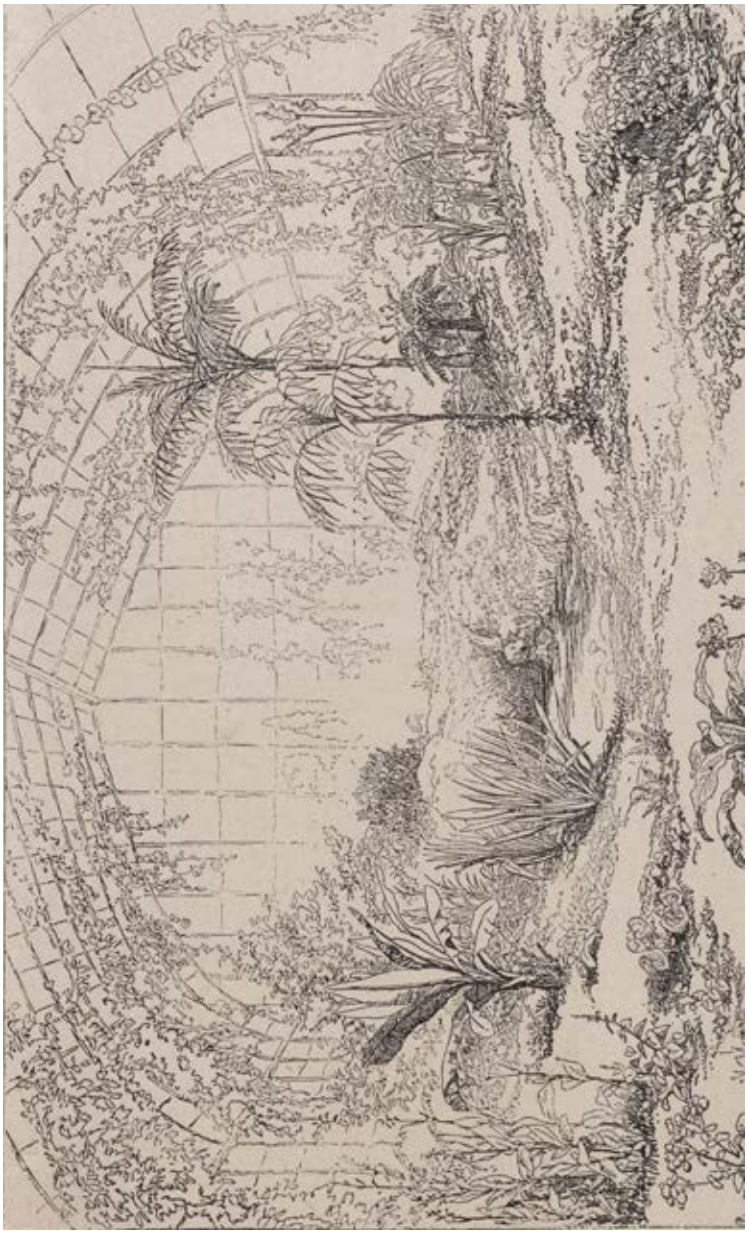

Fig. 9. Edouard André's proposal for a 'natural' conservatory – *Garden*, 1872. RHS Lindley Collections.

Soon after, at Oakworth Park near Bradford, the house of the safety match millionaire Samuel Holden, French contractors brought the French tradition of concrete rusticwork to England. There was an upper-level gallery from which visitors could see overhead views of the interior landscape, and the staircase was disguised as a dead elm in concrete.

While ferns were the initial beneficiaries of the interior landscape, the cult of foliage by the late 1860s had extended to include philodendrons, dieffenbachias, caladiums, rex begonias, monsteras, and a wide range of what were described as 'subtropical plants'. This became the stable pattern of vegetation in conservatories until the end of the century.

The natural conservatory

The early enthusiasts for interior landscaping did not carry their enthusiasm to the point of suggesting that gardeners should try to replicate the vistas of exotic countries. 'Follow out in such arrangements the *imitation-of-nature* principle', said Robert Fish, 'and our Paradises would become monstrous wildernesses' (Fish, 1852, p. 28). However, Dillwyn Llewellyn's orchid house had been made with just that purpose, and other voices would eventually be heard urging that conservatories should 'relieve the spectator from the impression that he is walking under glass, thus destroying the illusion of a tropical scene which the plants around him would otherwise convey' (Humphreys, 1851).

In 1872, the French botanist and garden designer Édouard André published a proposal for a 'natural' conservatory in William Robinson's magazine *The Garden*. It was to be laid out as a pair of dells, the plants scattered so as to avoid any appearance of massive groups. His instructions included the avoidance of massive rockworks, the clothing of structural members with climbers and the addition of dead trees to provide realism. Some degree of visible artifice was unavoidable, especially in the provision of comfortable paths: 'To try to imitate the forests of Brazil by compelling the spectator to scramble over the rotten remains of trunks of fallen trees, rough stones, and withered fern fronds, would be the height of absurdity' (André, 1872). But the accompanying illustration suggested a vista of great extent, to be viewed from a distance rather than strolled through.

André's proposals were speedily rebutted by Thomas Baines on the grounds that he was grouping together too many plants which required differing environmental conditions (Baines, 1872). The illustration, though, had a greater influence than the text. Within a decade, at Ascog Hall, on the Isle of

Fig. 10. Ascog Hall, Isle of Bute – *Gardeners' Chronicle*, 1879. RHS Lindley Collections.

Bute, a sunken fernery was built, only the roof above ground level, and the gardener created a massive display of tree ferns and foliage, to be seen by the visitor only from a single path:

> Then a most surprising sight presents itself … the view on entering extends 50 feet, comprising the Ferns, rocks, and water; a short space beyond we have a view, of about 80 feet in length, of rocks and Ferns growing upon them. … The beautifully selected pieces of rock which are here introduced have been collected and arranged by Mr. Todd, Mr. Stewart's able gardener. They are specimens from the sea-shore, and are so placed and arranged that the most scrupulous could fail to discover any reason for fault-finding (Williams, 1879).

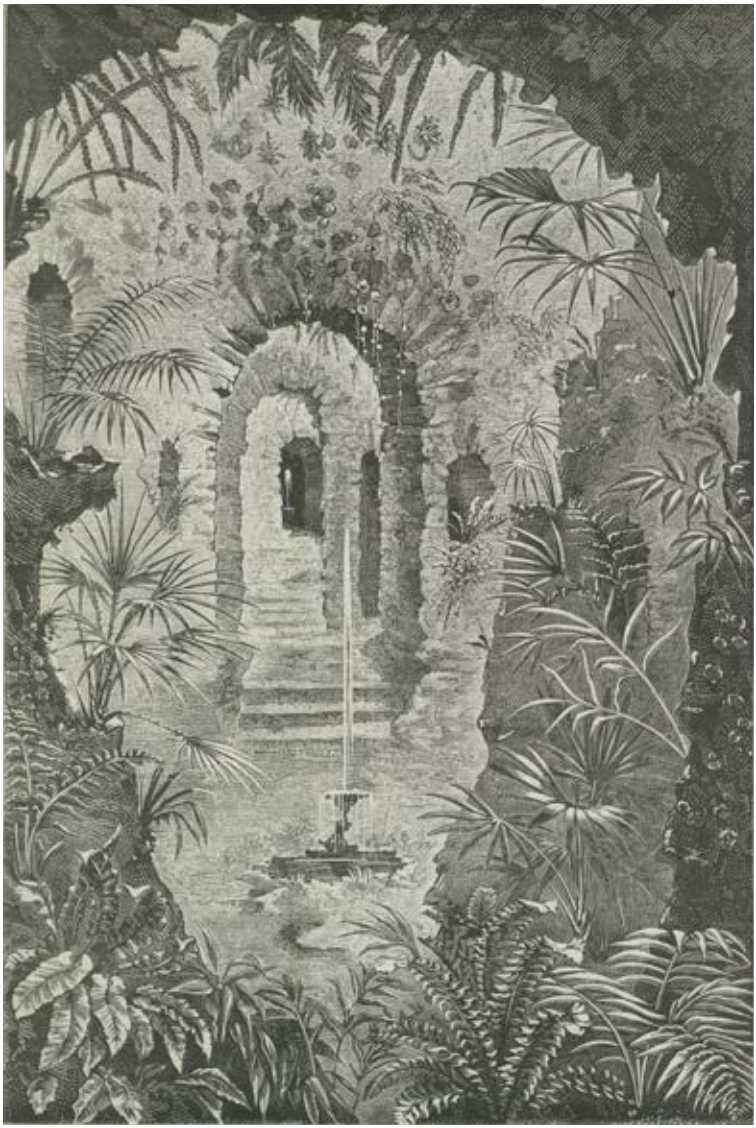

Fig. 11. Henry Harland's fernery, *Gardeners' Magazine*, Vol. 19, 1876. RHS Lindley Collections.

The decline of the conservatory

From one point of view the story of the conservatory in the late Victorian and Edwardian periods is one of continual expansion, as cultivation under glass extended itself throughout the social scale. Local authorities became persuaded of the educational value of glasshouses with interesting plant collections, and by the First World War most substantial parks in the kingdom could boast a conservatory. Some of the later conservatories illustrated in the gardening press show that social functions were taking over from horticultural, with plants pushed towards the periphery of the building, while dancing and other activities dominated the centre.

The First World War was the turning point in the conservatory's history. The Duke of Devonshire applied to the government for extra coal rations, but was refused, and in the winter of 1917 much of the plant collection in the great Chatsworth glasshouse died. In 1920 it was decided that it would be cheaper to demolish the building than to try to restock it, and it was dynamited. The next half-century would see the destruction of most municipal park glasshouses and the closure of most of the firms of manufacturers.

Table 3. **Conservatory plants, 1820s–1830s.**
Sources: J.C. Loudon, *The Green-house Manual* (1824), 2, pp. 131–133; Peter M'Arthur, Some account of a conservatory lately erected at The Grange, *Gardener's Magazine*, 1 (1826): 110–111; Joseph Paxton, A Select List of Greenhouse Shrubs, *Paxton's Magazine of Botany*, 3 (1837), pp. 177–178. Botanical names have been updated.

Loudon, 1824	The Grange, 1826	Paxton, 1837
Acacia spp.	*Acacia* spp.	*Acacia* spp.
	Adenandra fragrans	
Adenocarpus foliolosus		
	Andersonia sprengelioides	
Angophora floribunda		
		Anthocercis viscosa
Aotus ericoides		
	Aralia spp.	
Araucaria columnaris, &c	*Araucaria angustifolia*	
	Ardisia crenulata	
Astroloma pinifolium	*Astroloma pinifolium*	*Astroloma pinifolium*
Banksia spp. (all the genus)	*Banksia* spp.	
Beaufortia decussata	*Beaufortia decussata*	*Beaufortia decussata*, &c
Bignonia capreolata	*Bignonia capreolata*	
Billardiera longiflora, &c		
Boronia pinnata, &c	*Boronia pinnata,* &c	*Boronia denticulata*
		Bossiaea heterophylla, &c
		Bouvardia multiflora
Brachysema latifolium	*Brachysema latifolium*	
	Brexia madagascariensis	
Brugmansia arborea	*Brugmansia arborea*	*Brugmansia sanguinea*
	Burchellia bubalina	
		Calibrachoa linearis
	Callicoma serratifolia	
Callistachys lanceolata		*Callistachys lanceolata*
Callistemon rigidus	*Callistemon speciosus*, &c	*Callistemon speciosus*, &c
	Calodendrum capense, &c	
Calomeria amaranthoides		

Loudon, 1824	The Grange, 1826	Paxton, 1837
		Calothamnus quadrifidus
Camellia spp. & vars.	*Camellia* spp. & vars.	*Camellia* spp. & vars.
Campsis grandiflora	*Campsis grandiflora*	
		Camptosema rubicundum, &c
	Canna iridiflora	
	Cayaponia laciniosa	
	Ceanothus caeruleus	
		Chamaecrista fasciculata
		Chorizema henchmannii, &c
Chrysanthemum indicum		
	Cissus vitiginea	
Citrus (any or all)	*Citrus* (3 spp.)	
Clematis florida		
Clethra arborea, &c		
		Clinopodium coccineum
Cobaea scandens		
Convolvulus canariensis		
		Cordyline stricta
Coronilla juncea		
Correa reflexa	*Correa reflexa*	*Correa reflexa*
		Crassula coccinea
Crotalaria peduncularis		*Crotalaria purpurea*
Crowea saligna	*Crowea saligna*	*Crowea saligna*
Cryptostegia grandiflora		
Cunninghamia lanceolata	*Cunninghamia lanceolata*	
	Cussonia thyrsiflora	
Cytisus proliferus		
Dais cotinifolia		
Daphne odora		
Daviesia latifolia, &c		*Daviesia cordata*
		Dillwynia pungens
	Dioscorea elephantipes	
	Diosma spp.	

Loudon, 1824	The Grange, 1826	Paxton, 1837
Dolichos lignosus		
Dryandra sessilis, &c	*Dryandra sessilis*, &c	
		Edmondia pinifolia
	Elaeocarpus reticulatus	
	Enkianthus quinqueflorus	
Epacris impressa, &c	*Epacris impressa*, &c	*Epacris impressa*
		Eremophila maculata
		Erica, all kinds
	Erythrina sp. nov.	
		Escallonia rubra
	Eucalyptus cordata, &c	
Eutaxia myrtifolia	*Eutaxia myrtifolia*	
	Ficus elastica	
Fuchsia coccinea	*Fuchsia arborescens*, &c	*Fuchsia arborescens*, &c
Gastrolobium bilobum, &c	*Gastrolobium bilobum*, &c	
Genista canariensis		
	Glycine spp. [see *Wisteria*]	
Gnidia pinifolia	*Gnidia pinifolia*	
		Gompholobium confertum, &c
Goodia lotifolia		
Grevillea buxifolia, &c	*Grevillea sericea*	
		Hakea linearis
Hardenbergia comptoniana		
	Heliotropium sp.	
Hibbertia dentata, &c		
Hovea elliptica, &c	*Hovea elliptica*	*Hovea elliptica*, &c
Hoya carnosa		
Hypocalyptus oxalidifolius		*Hypocalyptus coluteoides*
Indigofera australis		*Indigofera australis*, &c
	Ipomoea indica, &c	
	Jacaranda mimosifolia	

Loudon, 1824	The Grange, 1826	Paxton, 1837
	Jasminum, 6 spp.	
		Kennedya, all spp.
		Lachnaea eriocephala
	Lagunaria patersonia	
Lambertia formosa, &c	*Lambertia formosa*	
	Lantana camara	
	Lasiopetalum, 5 spp.*	
		Lechenaultia formosa, &c
		Linum flavum
		Liparia splendens
	Lomatia silaifolia	
Lonicera japonica, &c		
		Lupinus mutabilis
Magnolia figo	*Magnolia figo*, &c	
Maurandya antirrhiniflora, &c		
Melaleuca diosmifolia, &c	*Melaleuca decussata*, &c	*Melaleuca*, all spp.
	Melastoma sanguineum	
		Mirbelia dilatata
	Musa coccinea	
Nerium oleander, &c	*Nerium odorum*	*Nerium odorum*, &c
	Osmanthus fragrans	
		Oxylobium arborescens, &c
	Passerina filiformis	
Passiflora caerulea, &c	*Passiflora* spp & hybrids	
Pelargonium carneum, &c		*Pelargonium*, any
	Persoonia lanceolata, &c	
		Photinia glabra
Pimelea linifolia		*Pimelea ferruginea*
Pittosporum tobira, &c	*Pittosporum*, 5 spp.	
	Platycerium stemaria	
Polygala fruticosa, &c	*Polygala*, 10 spp.	*Polygala grandiflora*

* presumably including *Seringia* & other genera

Loudon, 1824	The Grange, 1826	Paxton, 1837
Prostanthera lasianthos		*Prostanthera lasianthos*
	Protea argentea	*Protea*, all kinds
	Psidium cattleianum	
Pultenaea daphnoides, &c		*Pultenaea paleacea*, &c
		Punica nana
		Pyrus floribunda
	Rhododendron arboreum	*Rhododendron arboreum* vars
Rhododendron indicum vars*	*Rhododendron indicum* vars*	*Rhododendron indicum* vars*
	Rhodomyrtus tomentosa	
Rosa × odorata, &c		
Rubus rosifolius	*Rubus buergeri*	
		Salvia fulgens, &c
		Sarcocolla squamosa
		Senecio elegans
		Strobilanthes ciliata
		Styphelia viridis
	Syzygium australe, &c	
		Tecoma capensis
	Telopea speciosissima	
		Templetonia retusa
	Theophrasta sp. [*dentata* in text]	
	Tristania neriifolia	
Tristaniopsis laurina	*Tristaniopsis laurina*	
		Ursinia odorata, &c
	Viburnum odoratissimum	
		Wahlenbergia tenerrima
Wisteria sinensis	*Wisteria sinensis* †	
	Xeranthemum proliferum	*Xeranthemum proliferum*, &c
	Yucca gloriosa	
Zieria smithii		

* as *Azalea indica* † probably included as one of 5 *Glycine* spp.

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