In 1873, before a single road was laid at the Arnold Arboretum, founding director Charles Sprague Sargent packed a Wardian case full of ferns from the American West. Wardian cases—wood and glass boxes shaped like small, moveable greenhouses—were used for transporting live plants. They were often more delicate than typical cargo, so to ensure protection Sargent sent the box to England with a friend who also happened to be sailing across the Atlantic. He hoped the ferns, from California and Colorado, might impress his colleagues at the Royal Botanic Gardens, Kew, in particular the director, Joseph Hooker.

Sargent wanted to make sure that Kew’s collection of North American ferns was “as complete as possible.” In the April 2, 1873, letter that accompanied the Wardian case Sargent wrote to Hooker: “If … you have all you want, will you kindly send them on to the Jardin des..."
Plantes at Paris." Sargent hoped that Kew could send at least a few plants on to Paris: "I am sorry to trouble you in this way, but unfortunately we have not as yet any sure way of transporting living plants to Paris and I doubt not you are in constant communication with Dr. Decaisne."

Sargent's letter shows us a number of processes in motion during that time. While moving plants still relied on an important network of botanists, by the 1870s the trade in live plants around the globe had become extensive. This had only become possible because of the invention of the Wardian case. The letter also shows that botanists, arborists, agriculturists, and horticulturists from around the globe needed to remain in constant contact. Indeed, they could use one contact to begin a dialogue with another, in this case using Hooker to re-open contact with Paris. At all times these networks relied on reciprocity—one institution sends some plants and the receiver sends some back. One of the key ways a new contact was smoothed out, or an already established contact was asked for new plants, was to send them some from your own collection.

Sargent concluded his letter to Hooker by sending a list of desiderata—a list of plants that they needed at Harvard. He was not only hoping for plants for the new arboretum in Jamaica Plain but also plants for the botanic garden that then existed in Cambridge. Among the most desired were palms and agaves. "[A]s the Garden is so destitute of them that any-thing you can send will be most accept-able," wrote Sargent.

A few months later Hooker was able to satisfy Sargent's request by sending palm seeds plus some very good seeds of the Abyssinian or Ethiopian banana (*Musa ensete*, now known as *Ensete ventricosum*). This was a very rare plant to have in North America at the time because it did not travel well. In the same consignment Hooker also included a Wardian case full of rhododendrons (*Rhododendron*). In the following months Sargent would go on to return the favor and send another Wardian case of ferns to Hooker. And so the reciprocal relationship continued between them.

### The Challenge of Sending Plants

Many common horticultural or agricultural species, for example the Japanese umbrella pine (*Sciadopitys verticillata*) or even tea (*Camellia sinensis*), required the efforts of plant hunters and travelers to discover and introduce them.
Just keeping plants alive on a long sea voyage was a challenge for early travelers. As early as the seventeenth century plants arrived in Europe from around the globe, to the pleasure of plant enthusiasts. As the centuries wore on, more and more rare and exotic plants steadily made their way to Europe and North America. While some plants were sent as seeds or cuttings, many plants could not be transported in those forms and had to be sent as live specimens. For naturalists this amounted to a great challenge. As shipping increased in the early nineteenth century and the world became increasingly connected through exploration and trade, transporting live plants was still very difficult.

In 1819, John Livingstone, the keen botanist and surgeon posted in Macao for the East India Company, wrote to the Royal Horticultural Society on the challenge of sending live plants from China to London. Livingstone estimated that only one in one thousand plants survived the journey. He proposed a number of plans for the successful movement of plants. One was quite simply to send a gardener with any dispatch of live plants to make sure they were properly cared for on the voyage. But whatever the method was, Livingstone concluded in his November 16 letter to the Society, that it “becomes a matter of importance to attempt some more certain method gratifying the English horticulturist and botanist, with the plants of China.” John Lindley, also of the Horticultural Society of London, described the great challenge and care needed in sending live plants across oceans. In 1824, Lindley wrote, “The idea which seems to exist, that to tear a plant from its native soil, to plant it in fresh earth, to fasten it in a wooden case, and to put it on board a vessel under the care of some officer, is sufficient, is of all others the most erroneous, and has led to the most ruinous consequences.” Lindley proposed a more controlled and concerned approach to sending plants. Indeed, for many in London it came down to the type of case plants were sent in.

At this time naturalists and gardeners turned their efforts to discovering the best way to send live plants around the globe. Was it in a wooden box? Or were there other ways? Many methods for successfully moving live plants to destinations well beyond their native range were being tried. Accompanying Lindley’s paper to the Horticultural Society were designs for a glazed box that had been sent to him by the Governor of Mauritius, Robert Farquhar. One of the more interesting methods proposed was that of Nathaniel Wallich, pioneering botanist and surgeon for the East India Company, based in Calcutta; he sent a box that had a roof made with translucent shell inserts, which allowed light in. These early decades of the nineteenth century were an intense period of experimentation in sending live plants.

Ward’s Glass Case

Most inventions do not come about in a vacuum, and so it was with the Wardian case. Many plant transportation containers, some of which were quite successful, paved the way before the actual Wardian case was invented. It was a simple case made of wood and glass and takes its name from its inventor, Nathaniel Bagshaw Ward, a London physician with a keen interest in the natural world. Ward's improvement on
Sketch of the box used by Sir Robert Farquhar to transport plants from Mauritius to London in 1824. This box holds a striking resemblance to the common Wardian case that became widely used in the nineteenth century. From John Lindley, “Instructions for Packing Living Plants in Foreign Countries, Especially within the Tropics; and Directions for Their Treatment during the Voyage to Europe,” Transactions of the Horticultural Society of London 5 (1824).
the previous attempts was his proposal of an airtight system in which transpiration inside the case provides sufficient moisture to keep plants alive for extended periods. [We would call this system a terrarium today.]

In 1829, in a large sealed bottle partially filled with soil, Ward buried the chrysalis of a sphinx moth, with the hope that it would hatch. The moth never flew, but he observed changes inside the bottle. Sprouts of meadow grass (*Poa annua*) took life, so too did the common fern *Aspidium* (now *Dryopteris* filix-mas). Instead of worrying about the moth, Ward took the sealed bottle and moved it to a window that would get the northern sun. The plants inside survived for three years without water; in the second year he observed the grass inside bloom and the fern grew five fronds. Only after the lid rusted and rain water entered the bottle was the experiment over.

Many other experiments followed. Inside Ward’s house was an extravagant display of city gardening under glass. On March 6, 1834, John Claudius Loudon, the well-known garden designer and journalist, visited Ward’s house. He described it as “the most extraordinary city garden we have ever beheld.” It was also the implications of Ward’s gardening in glass cases that was important. Loudon added, “Mr. Ward has no doubt, that by boxes of this kind, with requisite modifications, he could transport plants from any one country in the world to any other country.” At the time, Ward was in the process of testing his new glass cases on an overseas voyage.

In 1833, Ward transported a perfectly packed sealed glass case containing a selection of ferns, mosses, and grasses from London to Sydney, Australia. On November 23, 1833, Ward received a letter from Charles Mallard, the ship captain responsible for the two cases: “your experiment for the preservation of plants alive … has fully succeeded.” The next challenge was the return journey. In February 1834 the cases were replanted with specimens from Australia. In Sydney the temperature was over 30°C (86°F), rounding Cape Horn temperatures fell to -7°C (19.4°F), at Rio de Janeiro it reached nearly 40°C (104°F), and eight months later when Mallard’s ship travelled up the Thames the temperature was below 4°C (39.2°F). When Ward and friend George Loddiges, of the famous Loddiges & Sons nursery in Hackney, went aboard the ship in London they inspected the healthy fronds of a delicate coral fern (*Gleichenia microphylla*), an Australian plant never before seen in Britain.

Following the first successful journey to Australia and back, Ward and his friends commenced moving more plants in the glass cases. In 1835, Ward sent six cases of ornamental plants to the head gardener for the Pasha of Egypt, and later, following this success, coffee plants were sent. George Loddiges was more ambitious. He put into circulation over five hundred cases to all parts of the globe. It is the ingenuity and wide use by Loddiges’s nurseries that established the Wardian case as the most compelling tool to use for transporting live plants.

In the nineteenth century, a Wardian case filled with ferns became a feature of many middle to upper class Victorian homes, includ-
ing many homes along the east coast of North America. This is where the Wardian case has largely been preserved in much historical literature—as occupying a significant place in the natural history crazes of Victorian England. By 1851 a Wardian case full of plants was exhibited at the Great Exhibition. Inside the Crystal Palace, people could view live ornamental ferns brought from far off regions; they could also view one of Ward’s glass bottles with a plant in it that had apparently not been watered for 18 years.

Casting our eye wider than the context of the Victorian fern craze, the scale of movement that the Wardian case facilitated is significant. Focusing on the movement of plants we see the extent to which the case was used as a unified transport technology in a time when the world was becoming increasingly connected.

Ward’s biggest contribution, building upon the efforts of others before him, was to propose the airtight system for keeping plants alive, as well as putting this technology into practice on many long voyages. Unlike others before him, it was also Ward’s promotion of his system for transporting live plants that was important. As well as his short book On the Growth of Plants in Closely Glazed Cases (1842, republished with illustrations in 1852), he also published numerous short articles in the popular gardening media promoting his system for transporting plants. And with Ward’s promotions the adoption of the case was extensive, not just by well-known nurseries like Loddiges, but by the...
British Royal Navy, French government expeditions, the Royal Horticultural Society, and many others.

**Travelling the Globe**

By 1841, Ward could add many North American ferns to his collection of global plants. He had formed a good relationship with the young Harvard botanist Asa Gray when Gray first travelled to London. Gray helped Ward accumulate an extensive collection, which he kept in glass cases in his home and put in taxonomic order using Gray’s textbook. But the Wardian case wasn’t just used between botanists on either side of the Atlantic. In the decades following the 1840s, botanical gardens, acclimatization societies (organizations that promoted the introduction of exotic plants and animals to see if they were adaptable), horticultural societies, and nurseries commenced wide use of the Wardian case to transfer plants around the globe.

One of the most well-known uses of the Wardian case was by the Royal Horticultural Society of England. It first experimented with the cases when they sent the plant explorer Theodor Hartweg to California and central America in 1836. Following this in 1848, a member of the Society, Robert Fortune, travelled to China and successfully used Wardian cases to move tea plants from China to India. In total nearly 20,000 tea plants were transplanted in what might be one of the world’s largest acts of botanical espionage. These set the foundations of the Assam and Sikkim tea industry in India. Often less known is that a

This illustration of the United States Propagating Garden on the National Mall in Washington, D.C., is from the 1858 *Report of the Commissioner of Patents: Agriculture*. The glass houses pictured on the left and right were built to receive the tea plants that were sent to the United States in Wardian cases by Robert Fortune.
decade later Fortune, this time working for the United States Patent Office, sent 26,000 tea seedlings in Wardian cases to Washington, D.C. This instigated the United States’ first experimental plant station in the center of the capital, although it is suggested that not much ever really happened with the tea shrubs.

The Wardian case was used in a range of other botanical appropriations. The cinchona tree, whose bark was used in quinine-based antimalarial drugs, was moved in secret from Bolivia by the Dutch and British to be transplanted to Java and India. The rubber tree (*Hevea brasiliensis*) was taken from its native South America and transplanted, via Kew Gardens, to the Malay and Ceylon regions in Asia. In each of these examples the transplanted regions became leading global producers of the commodity.

Many commercial crops in colonial regions were established with the help of the Wardian case. The dwarf Cavendish banana (a variety of *Musa acuminata*) was moved from China, via the Chatsworth Gardens in England, to the Samoan islands and spread throughout the region as a significant crop. When the French botanist Henri Lecomte was charged with establishing gutta-percha (*Palaquium gutta*, a tree from which a useful latex was extracted) plantations in the French colonies in Indochina in the late 1800s, he took with him plants safely packed in Wardian cases. The establishment of mango (*Mangifera indica*) production in Queensland, Australia, also relied on the case, used as early as the late 1840s to bring grafted mango trees from India.

The first Japanese plants to arrive in New England were carried in Wardian cases and delivered to horticulturists to be distributed in the Jamaica Plain (Massachusetts) area. Japanese umbrella pines, along with dogwoods (*Cornus*), rhododendrons, crabapples (*Malus*), and cypress (*Chamaecyparis obtusa*) survived the seventy-day journey from Yokohama to Boston, tightly and carefully packed into the sealed glass cases. The first package of plants was sent in 1861 by the physician George Rogers Hall and eventually found a home at Francis Parkman’s small three-acre summer estate on Jamaica Pond. The following year Hall returned from Japan with six more Wardian cases. These cases were filled with many varieties of plants; among them...
Botanical gardens, often with a large focus on economic botany, formed hubs of distribution to move plants around the globe. The significance of Kew Gardens as a global hub of scientific knowledge and a mover of economic plants in the age of empire has been well documented in various sources. However, the significance of the Wardian case has received little specific attention. Following the invention of the case, it is estimated that in just 15 years William Hooker, director of the Gardens at Kew from 1841 to 1865, imported more plants than in the previous century. In the following eras at Kew, when his son Joseph took over as director (from 1865 to 1885), followed by William Thiselton-Dyer (from 1885 to 1905), the Wardian case continued to be used extensively. From the 1860s into the twentieth century, plants were travelling to and from points including Shanghai, Ceylon, Batavia, Yokohama, Calcutta, Hong Kong, Trinidad, Tonga, Venezuela, Dominican Republic, Jamaica, Guyana, Natal, South Australia, and Melbourne.

In the cases were everything from Liberian coffee to orchids, tree ferns, sisal, tonka beans (*Dipteryx odorata*), mangoes, and tea. The connections covered the globe and were efficient. In one letter from August 21, 1877, the collector in India, George King, wrote to Thiselton-Dyer that it was quicker to send plants in a Wardian case from Calcutta to Kew than it was to get a case of plants from Sikkim to Calcutta.

With its own imperial interests Germany was not to be left out of the global movement. Estimates from the Berlin Botanical Gardens note that between 1891 and 1907 over 16,000 plants were moved by the Gardens. These included coffee, oil palms, cocoa, rubber, and bananas. They were moved between Berlin and Victo-
ria (now Limbe, Cameroon), Amani (Tanzania), Sokodé (Togo), and Simpson Harbor (today Rabaul, Papua New Guinea). German botanical gardens also played an important intermediary role when the sisal plant (*Agave sisalana*), cultivated for its tough fibers, was transplanted from Central America to colonies in Africa for the German East African Company.

Other botanical gardens played major roles in moving plants around the globe whether it was for acclimatization, commercial, or ornamental reasons. The world renowned *Jardin d’agronomie tropicale*, Paris, was a major hub for acclimatization and agricultural research for the French colonies. In the first decade of the twentieth century the garden sent more than 40,000 live plants to the colonies. At Dutch gardens, including the Amsterdam Botanical Gardens and Leiden Gardens, many plants passed through on their way to Asian colonies including cinnamon, clove, mango, and ginger. For the Dutch the gardens at Buitenzorg (Bogor), Java, was the central hub for plant movement. At Russia’s most prominent gardens in St. Petersburg, the German-born Carl Maximowicz became head of the botanical gardens, which
Specially crafted Wardian cases made by local Indonesian workers were used to send plants from the Buitenzorg Botanic Gardens, Java, in 1904.

Workers at the Jardin d’Agronomie Tropicale [Garden of Tropical Agronomy] in Paris prepare to send live plants in Wardian cases to the French Colonies, circa 1910.

With an interior botanical style inspired by the Wardian case, a rectangular terrarium sits near a New York apartment window in this photograph by Jessie Tarbox Beals, circa 1910 to 1930.
allowed him to develop an extraordinary array of Japanese plants. In each of these places the Wardian case proved an important technology for building collections and disseminating plants to other regions.

The United States became one of the most important users of the case in the early twentieth century (although there were many uses in the late nineteenth century, some of these noted above) because of the extensive usage by the United States Department of Agriculture. The Wardian case was used on many expeditions by American plant explorers importing everything from orchids to avocados and even insects. However, by the 1920s the Wardian case had become an expensive method of transport. There was also a change in the air as scientists, primarily entomologists, started to see the dangers of importing foreign plant material and biological matter. In a 1924 circular to the USDA, Beverley Galloway, the chief of the Bureau of Plant Industry, noted: “The Wardian case, a sort of small portable greenhouse, has probably been the means of scattering more dangerous insects, nematodes, and other pests over the earth than almost any other form of carrier; hence its use is not advised except under special instructions.” As quarantine became the order of the day, protecting the natural biota of a country became a much more significant goal of plant industries and scientists. In the eyes of gardeners, exotics still held value but they now had to compete with a greater value placed on native flora.

A Century of Exchange

The Wardian case is a persuasive and wide-reaching example of how a simple technology for moving plants had a major impact on the ecosystems we know and value today. It was a prime mover for botanical enterprises for over a century. But by the 1940s it was largely phased out, with the last journeys carrying ornamental plants occurring in the 1960s. The case was superseded by the use of polyethylene bags and temperature controlled air transport.

The Wardian case was extensively used by many different groups of people from across the globe to move many different plants; from scientists to gardeners, from ferns to bananas, from Australia to Boston, the case was put to good use. Collectively in the nineteenth and early twentieth century the use of Wardian cases facilitated a major plant migration across the globe. These plant distribution networks, established with the introduction of the Wardian case, are still in use today.

Further Reading


Lindley, John. 1824. Instructions for Packing Living Plants in Foreign Countries, Especially within the Tropics; and Directions for Their Treatment during the Voyage to Europe. Transactions of the Horticultural Society of London 3: 192–200.


Ward, Nathaniel B. Letters to Asa Gray, 1840–1868, Gray Correspondence Files, Archives of the Gray Herbarium, Harvard University Herbaria. [These can be read online through the Harvard Library.]