Chapter Six

The Glass Flowers

Lorraine Daston

My father used to say,
"Superior people never make long visits,
have to be shown Longfellow's grave
or the glass flowers at Harvard.
Self-reliant like the cat—
that takes its prey to privacy,
the mouse's limp tail hanging like a shoelace from its mouth—
they sometimes enjoy solitude,
and can be robbed of speech
by speech which has delighted them.
The deepest feeling always shows itself in silence;
not in silence, but restraint."

—Marianne Moore, "Silence"

Introduction: *Making Things Talk*

They seem wholly unremarkable at first glance: a stem of Alpine dodflax (*Thesium alpinum*) with tiny white flowers; a pine tree branch (*Pinus rigida*) with straggling needles and mottled bark; an iris (*Iris versicolor*) of deep violet, some of its blossoms already withered (color plate III). It could be a miscellaneous collection

of freshly gathered botanical specimens, displayed for some eccentric reason under glass. But there is nothing fresh, nothing even vegetable, about these plants. And they are not just under glass; they are made of glass. It is the triple triumph of art over nature that annually draws over a hundred thousand visitors to the Ware Collection of Blaschka Glass Models of Plants — or the Glass Flowers, as they are known far and wide, in poems and novels as well as tourist guides — at the Harvard Museum of Natural History in Cambridge, Massachusetts. First, there is the triumph of all artistic naturalism, the successful deception of the senses: these glass models are more lifelike than the most painstaking Dutch still life. Second, there is the triumph of enduring art over ephemeral nature: it is the essence of the beauty of flowers to be fleeting, but the blue delphinium blossom, even the half-yellowed leaf, are frozen in time, like an insect in amber. Finally, there is the triumph of form over matter, of artistry over the resistance of natural materials: the sheer unsuitability of hard, brittle glass to mimic the delicate fronds, soft petals, veined leaves, fleshy fruits, and thready roots of plants turns these models into wonders. What would be ordinary in nature becomes extraordinary in art.

The collection of 847 life-size models of over 750 species and varieties of plants is unique in the world, the work of two Dresden craftsmen, Leopold Blaschka (1822–1895) and his son Rudolph Blaschka (1857–1939), who in 1890 signed a contract with the Harvard botanist George Lincoln Goodale "to make glass models of plants, flowers, and botanical details, for Harvard University in Cambridge, Massachusetts, exclusively and to engage in the manufacture of no other glass models" for the annual sum of eighty-eight hundred marks over ten years.[1] Ultimately, the Blaschkas (after Leopold's death in 1895, Rudolph alone) labored for some fifty years (1886–1936) to produce the Harvard collection, which was financed by Elizabeth C. Ware and her daughter Mary Le

Ware in memory of Dr. Charles Eliot Ware, Harvard class of 1834.[2] Mary Lee Ware had attended Professor Goodale's botany lectures and over the years befriended the Blaschkas, visiting them at their workshop-home in Hosterwitz, near Dresden.[3] Over decades — before and after the First World War, during the hyperinflation of the early 1920s, after Adolf Hitler's rise to power in 1933 — the Glass Flowers made their well-packed way from Hosterwitz in Saxony to Cambridge, Massachusetts, financed by the ever-loyal and ever-generous Miss Ware.

What kind of things are the Glass Flowers? Much of their fascination derives from their unclassifiability — itself a paradox, since they were made and are still displayed in order to demonstrate post-Darwinian phylogenetic botanical classification.[4] They are at once undeniably artificial and flawlessly natural, in the tradition of mimesis that extends back to Pliny's story of the competition between Zeuxis and Parrhasius and includes not only illusionistic painting but also reptiles cast in bronze, Palissy ware, and automata.[5] In all these simulacra, artifice severs the usual connections between form and matter: the curtain Zeuxis attempts to draw is made of paint, not fabric; the innards of the Vaucanson automaton are made of metal and leather, not flesh and blood; the petals and leaves of the Glass Flowers are made of glass, not cellulose and chlorophyll. Matter does not matter. The naturalism is only skin-deep, an effect of pure appearances. Though the actual deception of appearance taken for reality lasts only for a moment, the pleasure of potential deception lingers long.[6]

But the Glass Flowers were intended to have a closer connection with nature than these other delightful counterfeits. The botanists who commissioned them and the artisans who fashioned them described them from the outset as "scientific models" to be used for botanical instruction along the most advanced lines, as these were conceived at the turn of the twentieth century. Under

this description, the verisimilitude that is called illusionism in art becomes scientific accuracy. Yet once again the classificatory label hangs askew. Most scientific models aim to lay bare the essential principles according to which this or that domain of phenomena operate: an orrery shows the arrangement of planetary orbits in the solar system but does not look like the solar system; the hydraulic model of supply and demand does not look like the market.[7] Metaphorically, one might say these models are anatomical, penetrating beneath appearances, whereas the Glass Flowers remain gloriously epidermal.

The Glass Flowers were not the only such "epidermal" models made in the late nineteenth century; scientists also ordered scores of exact replicas of, for example, embryos and sponges.[8] But even circa 1900, there was something distinctly odd about botanists' indulging in this taste for appearances exquisitely mimicked. Since the illustrated herbals of the mid-sixteenth century, botanists had striven to represent the species type of plants in the images that accompanied their verbal descriptions. These illustrations were usually composites drawn from several exemplars of the same species, so as to capture the characteristic aspects of the plant by filtering out idiosyncratic details that could hinder identification of a specimen in the field. As the German botanist Matthias Jacob Schleiden preached in his influential 1842 textbook, the goal of both observation and drawing in scientific botany was to fuse particular facts and visual impressions about plants into a "perfect and complete view [*Anschauung*]," to know what to overlook.[9] In collaboration with the illustrator Isaac Sprague, the Harvard botanist Asa Gray (Goodale's immediate predecessor) attempted to represent not just a species but an entire genus by a single image in his *Genera of the Plants of the United States* (1848–1849) (figure 6.1).[10] Hence nineteenth-century botanists were skeptical about image-making procedures like

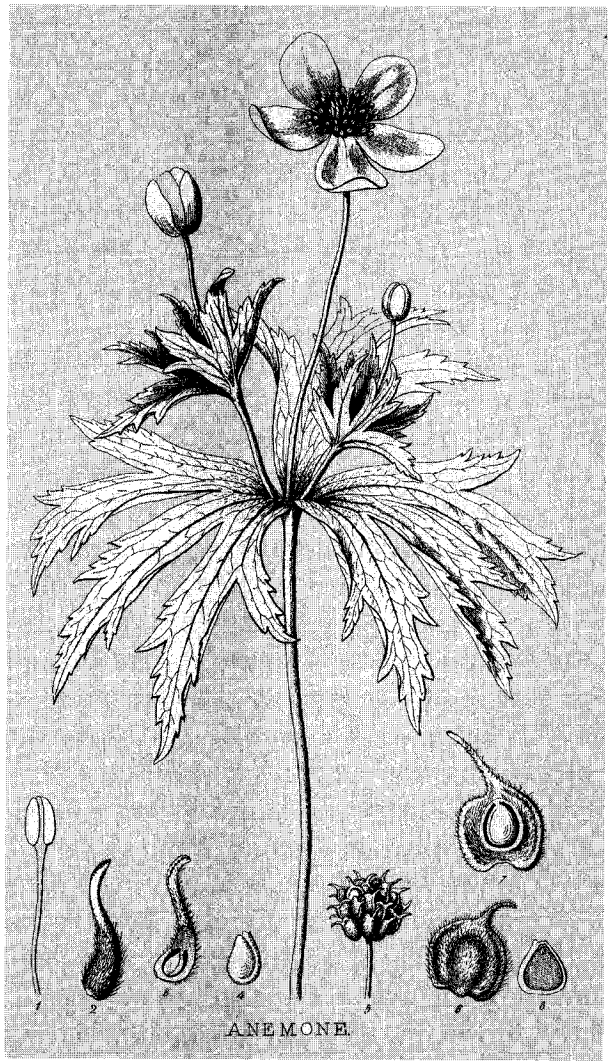

Figure 6.1. *Anemone pennsylvanica*, for the genus *Anemone*, order *Ranunculaceae*, from Asa Gray, *Genera florae Americae borealiorientalis illustrata. The Genera of the Plants of the United States Illustrated by Figures and Analyses from Nature by Isaac Sprague*, 2 vols. (Boston: J. Munroe and Company, 1848–1949), vol. 1, pl. 4.

the *Naturabdruck*, in which plants left imprints on specially prepared paper, and the photograph, both of which registered the specifics of the individual plant at the expense of the general type.[11] Latter-day botanists seem embarrassed by the collection, which is too faithful to misleading appearances even — perhaps especially — to teach students how to pick out the essential morphology of plants.[12] Wherein lay, then, the scientific utility of the meticulously detailed Glass Flowers, with their yellowed leaves and wilted blossoms?

Although botanists now shrug their shoulders over the Glass Flowers, the models are not friendless. To send a note of inquiry concerning the Blaschka models (including those of marine invertebrates made before they embarked on the Glass Flowers) is to become quickly enmeshed in an international network of high connectivity. Start at any one node, and you are very soon linked up to other aficionados. The models inspire the kind of keen interest that solidifies far-flung devotees into what the critic Miguel Tamen has called "formal and informal societies of friends of interpretable objects."[13] The objects in question may be novels by Samuel Richardson, agates, Byzantine icons, or ancient Etruscans — anything or anyone who cannot speak for itself, thereby inviting representation by those who can speak and to whom the objects matter. The capacity to call such a society of friends into existence is as much a part of a thing's thingness, of its reverberations in the world, as its material properties like weight and chemical composition. As Tamen points out, a society of friends acts to keep its favored objects visible — for example, in museum displays rather than in museum attics — and in extreme cases, as in the Byzantine dispute over iconoclasm, to keep them in existence, to protect them from willful or careless destruction. It is perhaps unlikely that someone (an iconoclastic botanist?) will take a baseball bat to the Glass Flowers, but, given their fragility, extraordinary measures must be taken just to preserve them from everyday accidents. The models are rarely allowed to travel, and then only a very few of them, once transported by hearse and now in custom-made crates filled with space-age contoured foam (figure 6.2). Befriending the Glass Flowers can be a strenuous and costly business, demanding the mastery of an arcane body of knowledge, huge shipping budgets, and a delicacy of touch that at times rivals that of the Blaschkas themselves.[14] Sometimes friendship can border on monomania, as when a Harvard professor of botany reacted to the bombing of Pearl Harbor in 1941 by suggesting that "[Harvard] Museums must begin to think in terms of permanent bomb-proof quarters for their irreparable treasures of which the Blaschka Collection, the only collection of its kind in existence, is certainly one."[15]

As the phrase suggests, friends of interpretable objects don't just guard the objects singled out for care; they attach meanings to them. In the case of the Glass Flowers, these interpretations are very thick indeed. Historians write about when and how and why the Blaschkas made the models; chemists analyze their structure and composition; connoisseurs of glassware remark on the subtleties of style and technique; poets enlist them to evoke the pungency of a certain time and place; artists juxtapose them with scenes of war as symbols of the all too easily shattered; visitors to exhibitions express their fascination and enthusiasm in on-line articles.[16] In this essay, I shall contribute to none of these readings, although I have profited from all of them. My curiosity about the Glass Flowers veers off in another direction: What is it about the Glass Flowers that wins them friends, that turns them into things that talk? What makes an object irresistibly interpretable? Another way of putting these questions is to recall the original meaning of "amateur" (*aficionado*, *amatore*, *Liebhaber*), which had nothing to do with lack of training and competence — quite the contrary.

Figure 6.2. Curatorial associate Susan Rossi-Wilcox attaches individually cut foam supports to the model of *Panicum xanthophysum*, which will then be packed in a series of foam-lined boxes and a wooden crate for travel from the French millennial exhibition in Avignon back to the Botanical Museum at Harvard University. Courtesy of Susan Rossi-Wilcox.

Amateurs expertly cultivated their subjects out of affinity rather than utility, for love rather than money. My quarry here is the ways in which the Glass Flowers attracted amateurs in the root sense of the word – scientists, patrons, curators, museumgoers, the Blaschkas themselves – and the sources of these affinities. But the Glass Flowers aroused antipathies as well as sympathies, made enemies as well as friends. Things can be made to talk out of hatred as well as love. The very virtuosity and accuracy that won the Glass Flowers so many admirers also sowed suspicions in some quarters that they were unscientific, even antiscientific. The gradual transformation of the "Glass Models" into the "Glass Flowers" charts their migration from scientific tool to virtuoso craftsmanship, and with it the ups and downs of the uneasy relationship between botany and beauty.

Glass

One of the most improbable features of the Glass Flowers is their glassiness. Brittle, hard, colorless, smooth – there could hardly be a more counterintuitive choice of a medium for representing the pliant, richly textured, and brilliantly colored vegetable kingdom. Moreover, there was a tradition dating back to at least the eighteenth century of making artificial flowers out of the more malleable materials wax and silk; the nineteenth-century Mintorn models, still preserved at the Royal Botanic Garden in Kew, show the high degree of verisimilitude attainable in wax (color plate IV).[17] Wax can be easily tinted in nuanced shades; the correspondence between Rudolph Blaschka and the Harvard botanists was, in contrast, full of the vexations of finding the right pigments and getting them to bond to the glass: "You know the artistic result however you would be surprised if knowing at all the immense difficulty we had to struggle against when trying to copy the natural shades and textures. There were moments in which we were

exceedingly tired of the whole matter."[18] The arguments made in favor of glass over wax models – greater longevity – sound more implausible still, considering the precautions that must be taken simply to move one of the glass models from one case to another.[19]

The Blaschkas had in fact first made a name in scientific modeling by supplying natural history museums and university institutes with glass models of other organisms not easily preserved. Many collections throughout the world still own a few examples of the exquisite Blaschka models of marine invertebrates (color plage V).[20] Like the Glass Flowers, the models of jellyfish and sea anemones fascinate by their beauty and verisimilitude. But they do not evoke the same wonder. The transparent delicacy of nature in this case comes too close to that of glass; there is a more obvious connection between medium and subject matter, which is probably why zoologists like Ernst Haeckel and Franz Eilhard Schulze turned to glassworkers like the Blaschkas to stock their natural history museums in the first place. Leopold Blaschka himself seems to have hit upon the idea for the models when jellyfish observed at sea during an Atlantic crossing in 1853 reminded him of the glass worked by generations of Blaschkas in Bohemia. Years later, in an 1880 lecture titled "Hydroidquallen oder Craspedoten," presented to the local scientific society of Dresden, Rudolph Blaschka reported how his father had taken a particular interest in the jellyfish netted by the sailors, "because of their glassy appearance."[21] By 1871, Leopold Blaschka's catalog had come to offer three hundred models of aquatic organisms; in 1888, catalogs advertised some seven hundred models, sold to universities and museums throughout Europe and the United States.[22]

The Blaschkas' route to plant models was considerably more circuitous, through jewelry making, prostheses (glass eyes), and horticulture rather than through scientific botany. Leopold Blaschka had studied gem cutting; the family workshop in Bohemia had

already established a reputation in the late eighteenth century for high-quality glass paste gems and beads. Starting in the 1860s, he had fabricated floral brooches and earrings from glass. His first glass models of plants were commissioned and exhibited by Prince Camille de Rohan, founder of the Bohemian Society for the Promotion of the Garden Trade, and were mostly of orchids, the most luxurious and precious of cultivated flowers.[23] The Blaschkas, father and son, were to use jewelry-making techniques throughout their careers in fashioning both their zoological and their botanical models.[24] Medieval naturalists had often likened the beauties of flowers to those of gemstones; in the work of the Blaschkas, this analogy became strangely literal. Parts of the glass models – leaves, petals, tentacles – were strung on wires like beads in a necklace.

Since the mid-seventeenth century, the depiction of flowers, insects, and other *naturalia* for the purposes of natural history illustration had been closely intertwined with images of the same objects made for the luxury trades: embroidery, porcelain painting, interior decoration, silk weaving. An illustrator and an artisan were often one and the same person.[25] In their own minds at least, the Blaschkas continued this conflation of scientific representation and the decorative arts. One of Leopold Blaschka's earliest catalogs for the models of marine animals advertised them as "decorations for elegant rooms";[26] although later catalogs were pitched to scientific institutions, Rudolph Blaschka still remembered the marine models decades later as "a beautiful show."[27] Haeckel, who was one of the earliest and best customers for the zoological models and who lent the Blaschkas books from his library, surely influenced the symmetrical, sinuous forms of the models of sea anemones and medusae. In his *Monographie der Medusen* (1881), Haeckel had emphasized the "geometric basic form [*Grundform*]" of the organisms, and the magnificent lithographs (partly drawn

by Haeckel himself, with the help of the artist Adolf Giltsch) served as the basis of some of the Blaschka models (figure 6.3). The manner in which the Blaschkas made some of their earliest models would have emphasized symmetry out of practical necessity as well as aesthetic preference and zoological principle. Relying heavily on the already stylized illustrations of marine organisms in Haeckel and especially in Philip Henry Gosse's *A Naturalist's Rambles on the Devonshire Coast* (1853), the Blaschkas made their own reverse drawings of these to serve as preparatory material for the "back" of their three-dimensional models (figure 6.4).[28] There would, however, have been other sources for the Blaschkas' artful compositions: especially celebrated works of natural history illustration, such as John James Audubon's "magnificent" *Birds of North America* (1831–1838), which Rudolph Blaschka recalled having admired around 1875 in the library of the Academia Leopoldina-Carolina in Dresden.[29]

Words as well as images linked the Blaschkas' models to their glassy medium, and both models and medium to Leopold Blaschka's first métier as jewelry maker. In his descriptions of aquatic organisms, Gosse often compared them to jewels or glass: the tadpole of the *Amaroucium proliferum* reminded him of "a brilliant little ruby"; he christened a newly discovered medusa species the "Glassy Aequorea" and described it as "without a trace of colour ... [yet] exquisitely beautiful."[30] In a report on medusae to the Dresden scientific society Isis, Rudolph Blaschka remarked on how their "delicate, glass-like colors enhanced the elegance of their appearance."[31] The associations with the glitter of glass and gemstones, expressed in language equally precious, persisted long after the Blaschkas had abandoned models of jellyfish and polyps for those of orchids and Virginia creepers. Even the humblest weed modeled by the Blaschkas "has in its center lovely urns or caskets or basket shaped receptacles of purest crystalline texture,

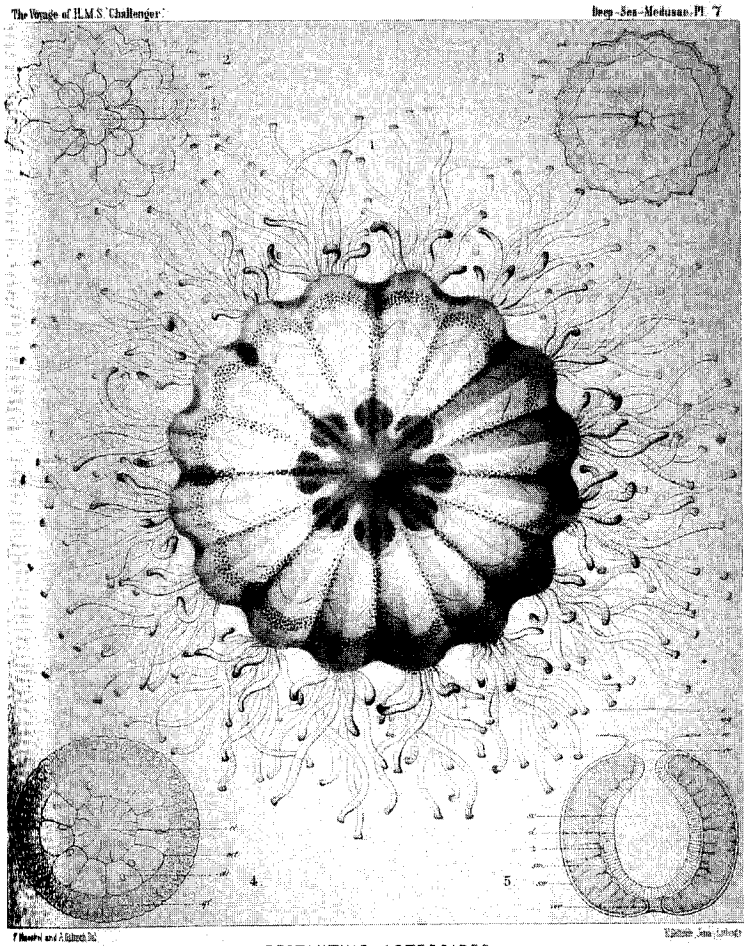

Figure 6.3. *Pectanthis asteroides*, from Ernst Haeckel, *Monographie der Medusen* (Jena: Gustav Fischer, 1881), table VII. Courtesy of the Staats- und Universitätsbibliothek Göttingen.

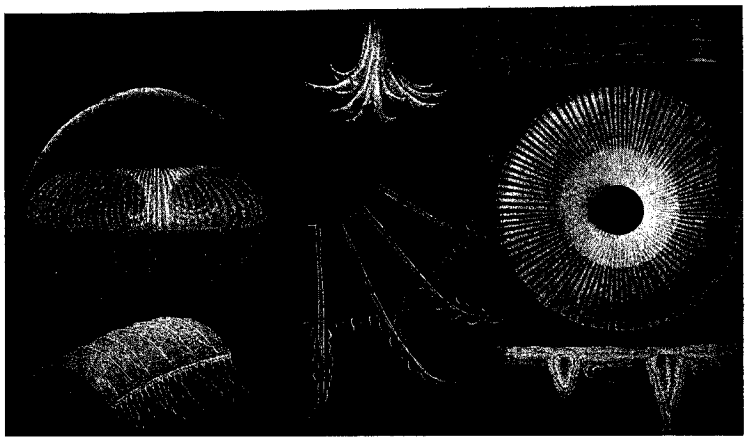

Figure 6.4. *Aequorea Vitrina*, from Philip Henry Gosse, *A Naturalist's Rambles on the Devonshire Coast* (London: John Van Voorst, 1853), pl. XXIII.

heaped high with tiny amber-colored or golden eggs of the pollen dust," rhapsodized an 1894 report in a trade magazine on the Ware Collection at Harvard's University Museum.[32] Just as the art of the maker of paste jewelry lay in disguising glass as gemstones, so the art of the Blaschka models consisted in counterfeiting flora and fauna out of glass yet somehow still evoking a scene from the Arabian Nights of treasures gleaming from richly worked caskets.

If the decorative associations of *naturalia* like flowers and shimmering, delicate marine organisms were strong and ubiquitous, reinforced by the Blaschka family experience designing costume jewelry, there was nonetheless something remarkable about their almost mystical allegiance to glass. Glass had been the medium of the Blaschka family for generations in their native Bohemia, whose glassworks had by the seventeenth century surpassed those of Venice to dominate the world market;[33] Leopold Blaschka once told Goodale that the only way to become an accomplished glassworker was to have a father, a grandfather, a great-grandfather with the same skills and tastes.[34] When Rudolph finally married in 1911, he and his bride spent their honeymoon in northeastern Bohemia, where he "had the splendid chance to see yet the building of the 200 years old glass-factory called Zenker-Hütte where my great-grandfather was master about 130 to 150 years ago."[35] Leopold and especially Rudolph pored over chemical treatises, experimented with pigments and enamels, conducted field research (Rudolph made one field trip to the Adriatic to study marine animals in situ and two botanical collecting expeditions in 1892 and 1895 to North America), made microscopic studies of plant organs, and joined the local natural history society.[36] Whereas Leopold was described in the Dresden city tax records and the rolls of the Isis natural history society simply as a "*Glasskünstler*," Rudolph was designated by the same society by the more specialized title

"*naturwiss.*[*entschaftlicher*] *Modelleur*." Yet the Blaschkas remained craftsmen, and their medium remained glass.

If anything, the long years of work on the Glass Flowers deepened this identity as artisans and this identification with glass. It is possible to see the Blaschka workshop as becoming more scientific over the course of decades, especially once Rudolph continued alone after his father's death: whereas only a minority of the marine models had been prepared from nature studies,[37] most of the models for the Glass Flowers came from plants cultivated in the Royal Gardens at Pillnitz or in the Blaschkas' own garden at Hosterwitz, dried specimens sent by the Harvard botanists, or sketches made by Rudolph during his collecting expeditions. In later letters to his Cambridge correspondents, Rudolph fretted about the possible errors introduced by substituting cultivated for wild plant varieties, vividly recalled the habitus of plants he had seen on his North American collecting expeditions, and rejected illustrations in favor of his own microscopic investigations of plant anatomy.[38]

Yet the development in the artisanal direction was equally strong, to the point of willed anachronism. Whereas the early Blaschka models had made heavy use of commercially prepared glass and pigments, both the correspondence and the chemical analyses indicate that the later models were fabricated almost entirely from scratch in the Hosterwitz workshop.[39] When Goodale had first visited the Blaschka workshop in late 1889, he had found the worktable cluttered with "rods and tubes of glass, and blocks of colored glass," which surviving ledger books show to have been ordered in bulk from commercial suppliers.[40] But when Mary Ware visited in 1928, Rudolph made most of the glass and all of the pigments by himself:

> One change in the character of his [Rudolph Blaschka's] work and, consequently, in the time necessary to accomplish results since I was

> last here is very noteworthy. At that time, he bought most of his glass and was just beginning to make some, and his finish was in paint. Now he *himself* makes a large part of the glass and all the enamels, which he powders to use as paint.... He has dozens and dozens of little bottles with colored powders and little boxes labeled with colored enamels that he makes himself, and powders for paint.[41]

Rudolph railed against customers who "want me to do lots as a factory of a hundred workmen" when he was trying single-handedly "to contrive new methods in apparatus, coloring, preparing of enamels, etc."[42] Unbendingly committed to glass as a modeling medium with which "to reproduce the infinite variety of shade and texture, the often unattainable beauty of nature," and freed from the vicissitudes of the market by Harvard's unflagging demand for ever more models, Rudolph turned his back on the industrial products his father had used routinely and became an artisan of an almost archaic stamp.[43] By 1906, after nearly twenty years of making models exclusively for Harvard, Rudolph had taken to describing his labors as his "life work," in pointed contrast to a "business."[44]

Work

There was something magnificently mad about this commitment to glass. Not only did the tendrils and buds, the pistils and stamens, the bark and fruits all have to be molded by hand out of heated glass; the brittle models then had to be transported from Dresden to Cambridge. In feats of packing that almost rivaled the artistry of the models themselves, each tiny glass part was wired to the base of a firm cardboard box, then cushioned with tissue paper; surrounded by packing straw, the covered boxes were next packed in a large wooden crate; the crate was then packed in more straw and swaddled with burlap.[45] The love of glass exacted infinite

pains, as well as virtuoso tact, and not only from the makers of the Glass Flowers. The Glass Flowers did more than crystallize labor; they multiplied it. Everyone who came into contact with them — the model makers, the curators, the botanists — added their mite of care and concentration to the horde. By a peculiar kind of contagion, the Glass Flowers obliged those who dealt with them to assume the laborious, detail-obsessed attitudes and gestures of their makers. The steady hands and dexterity of Louis Bierweiler, who cared for the models at the Harvard Botanical Museum for sixty-three years (1901–1964), became, for example, a local legend in their own right.[46] A moment's indifference, inattention, or clumsiness in packing and unpacking, mounting and dismounting, even inspecting and drawing a Blaschka model (don't sneeze) could have irreparable consequences. Work was as much a part of the essence of the Glass Flowers as glass.

It was a peculiar kind of work, to be sure. Not backbreaking but painstaking, it was the work of delicate gestures, strained eyesight, focused attention, and, above all, vast patience. Nothing infuriated the Blaschkas more than the rumors (still rife) that they were in the exclusive possession of "secrets" that allowed them to produce the Glass Flowers effortlessly. Responding to an American newspaper report that the Glass Flowers were made by "certain secrets of moulding and annealing," Rudolph Blaschka insisted:

> The technical part of this work is only depending from the technical experience, above all from the skill and energy of hands and strain of eyes, and rarely there will be any other work which is so exclusively dependent from pains and succeeding as this. At first a man must be initiated into the technical rules of this profession, it may be called trade, art or science. After this the struggle of life commands: Help yourself! If steadiness, enthusiasm and ambition are present, the

> young man is getting skilled. These rules have been taught to me by my father 38 years ago, just as they were taught to him by his father.[47]

Mother as well as father contributed to the abilities that made the Glass Flowers possible, with her "remarkable eyes which enable us to see the tiniest details with the unaided eye"; models that the Harvard botanists examined with a magnifying glass were made by the Blaschka family by eye alone.[48] A single model might cost as much as seven weeks' work. After his father died, Rudolph worked alone, without an assistant, and sometimes longed to rest, envying "such vacations as the Professors and students enjoy every year."[49] Yet though the work was unrelenting, it was not joyless. Rudolph also wrote of his "passionate love of this work and study of nature," and in the cold, hungry days following Germany's defeat in the First World War, he "rejoiced at getting young again in this work" provided by Harvard's continuing orders for models.[50]

Although the Blaschkas were incensed by the talk of craft secrets that seemed to tar them with the brush of charlatanism, the fabrication of the Glass Flowers impressed even those who observed it firsthand as mysterious. But these were mysteries as measured against the standards of late-nineteenth-century factory production rather than tricks of the trade. Almost every account of the Glass Flowers, official and unofficial, emphasized that they were handiwork, not machine-made: "All the modelling has been done by their own hands, a marvelous example of concentrated and conscientious effort."[51] Moreover, each model was unique and made by the Blaschkas themselves, who refused all assistance as insufficiently qualified — an apprentice would only "bungle and spoil things."[52] The terms of Harvard's contract with the Blaschkas were monopolistic, preventing even the Blaschkas from replicating

their own models for other customers (who would come calling in Hosterwitz from time to time in the person of professors from German universities seeking models for their own museums).[53] After his father's death, Rudolph gradually withdrew still further from the imperatives of industrial and commercial production, making rather than buying his own materials, refusing to be rushed by Harvard's anxious inquiries as to when the models would be ready, and rarely venturing out of his own garden, much less to nearby Dresden. He became an autarchic recluse who occasionally deigned to receive visitors – a *Geheimrat* from a Berlin museum, the queen of Saxony and her ladies, Professor Goodale and Miss Ware – drawn to his workshop by the mysteries of his craftsmanship.

These visitors left as baffled as they came, even if they were permitted to watch him at work. Goodale, his wife and son Francis, and Ware spent a sweltering August afternoon in 1899 at Hosterwitz watching Rudolph make various leaves and flowers and quizzing him about his methods. In a detailed letter to the chemist Charles W. Eliot, then president of Harvard, Goodale described how red-and-orange flames were used to color the glass, how even at 95 degrees Fahrenheit all doors and windows were kept closed, lest the slightest breeze make "the perfectly steady point of the flame" flicker, how the glass did not fracture when cooled. But all he was able to report about the actual making of the models was the bare act of creation: "Under his hands the flowers were created and nothing more marvellous has ever been seen by any of us."[54] It was the inscrutability of skill and sensory acuity (a small flower made by Blaschka's naked eye could only be inspected by the onlookers with a powerful lens), coupled with modes of production that were at once ante- and anti-industrial, that fed the legends about the Glass Flowers. The mythology of the Glass Flowers developed in explicit counterpoint to the modern factory:

> In the time of the Middle Ages almost all trades or handicrafts had their mysteries.... It is very different now. If you visit the great factories, the proprietor or the foreman will show you how the complicated machinery works.... Still, some of the secrets of the handicraft remain and one of the most interesting of these is the wonderful art of the Blaschkas, which no other worker in glass has been able to learn or in any way imitate.[55]

In the age of mechanical reproduction and mass markets, the Glass Flowers were nonreplicable objects made by hand and from scratch by noninterchangeable laborers for a single customer.

It was perhaps this cult of work conceived as close observation, delicate manual skills, and taking pains that drew Goodale to the Blaschkas in the late 1880s. There was otherwise apparently very little to connect his brand of microscope-centered analytic botany with the mimetic naturalism of the Blaschka models. Goodale belonged to the generation of botanists who, following mostly German examples, turned from the external morphology to the internal physiology of plants and who worked mostly in a laboratory with a microscope rather than in the field or herbarium.[56] In his 1885 textbook on physiological botany, the illustrations were spare and schematic and mostly depicted microscopic sections of plant tissue (figure 6.5). An 1879 text on common plants prepared for Boston schoolteachers described the flower as "a complicated mechanism made up of simple parts" and illustrated the point with a gear-like diagram of a standard blossom (figure 6.6).[57] Yet Goodale was ferocious on the subject of first-hand, help-yourself observation of live plant specimens:

> The teaching which is advised in this course of botanical lessons is based upon the belief that the pupil must earn his facts; that, in general, facts which a pupil may acquire for himself are to be placed

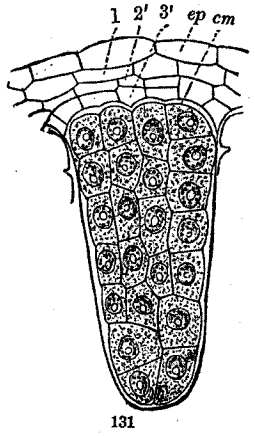

Figure 6.5. Magnified *Orchis maculata* pollen mass, from George Lincoln Goodale, *Physiological Botany: Outlines of the Histology of Phaenogamous Plants* (New York: Ivison, Blakeman, Taylor, and Company, 1885), p. 171.

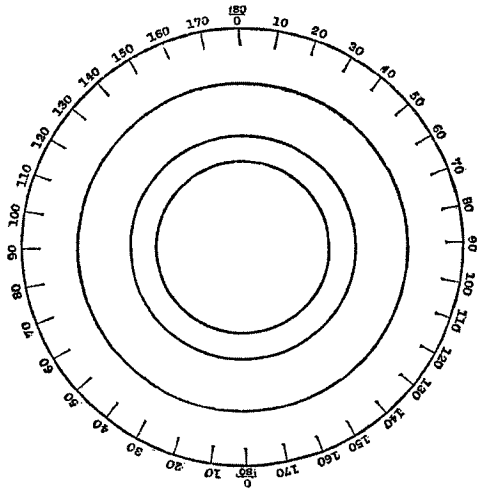

Figure 6.6. Schematic blossom diagram, from George Lincoln Goodale, *Concerning a Few Common Plants*, 2nd ed. (Boston Society of Natural History, 1886), p. 43.

> within his reach, but not in his hands. He must make some exertion to get knowledge, in order that it may become his. But in what way can a pupil be led to exert himself? Certainly not by having every thing done for him.[58]

It was pernicious to provide pupils with an analytic classificatory key before they had made a personal investigation of plant morphology with minimal aid from the teacher; good botanical illustrations had their place but "must never be used to the exclusion of fresh specimens or well-preserved dry ones."[59] Goodale's creed of the "wholesome painstaking" also extended to more advanced students. The best tools could be the simplest, provided they were deployed with sufficient dexterity: "Sharp, delicate needles, by which the parts may be separated by teasing, are often better than any cutting instruments."[60] Training in the modern botany of the microscope was a discipline for the hands as well as for the mind and eye.

This insistence on self-sufficient observation and manual skill, combined with a climate that precluded botanical fieldwork for a good part of the academic year, may have been what dispatched Goodale to Dresden to visit the Blaschkas, although he had not seen their earlier botanical models, burned in a fire in Liège and never commercially advertised. As first director of the Harvard Botanical Museum, however, Goodale would certainly have seen the Blaschka models of marine invertebrates, which were energetically advertised and marketed all over the world, in the neighboring Museum of Comparative Zoology founded by Louis Agassiz.[61] Although botanical illustrations, especially those of physiological botany, tended toward skeletal line drawings, Goodale's pedagogical ethos of strenuous observation required representations of an entirely different kind. If the plants themselves were not available, students would have to train their powers of attentive comparison

and judgment on replicas indistinguishable from the originals. Goodale hoped that the Blaschkas would create a perpetual garden, always in bloom, with which to instruct Harvard students in the specialized botanical ways of seeing and analyzing plants. Even settled, snowbound botanists — Cambridge was notorious for its long winters — could sharpen their eyes and memories on the Blaschkas' perfect replicas of plants year-round. The Glass Flowers were perhaps the culminating example of the nineteenth-century museum director's burning ambition to move nature indoors (figure 6.7).

Accuracy

In J.G. Ballard's short story "The Garden of Time," a garden of glassy flowers preserves the last refuge of an aristocratic couple against oncoming hordes until the final blossom has been plucked.[62] Similarly, the Blaschka glass models were intended to hold the forces of corruption and decay at bay, overcoming the imperfections of plants dried and flattened in a herbarium or bloated and bleached in alcohol. They would form a timeless garden. But a garden for whom, and for what use? By the time Goodale died in 1923, the answer had become clear: for the edification of the general public who came by the thousands each year to visit the Ware Collection, Harvard's most popular attraction by far. The Glass Models had definitively become the Glass Flowers. The answer around 1900 was, however, more ambiguous, as ambiguous as the declared mission of university museums, which were meant to serve simultaneously the interests of scientific research and public education.[63] The Ware Collection was originally conceived as much as a collection of scientific models as a magnet for crowds and donors. Goodale unabashedly exploited this magnetism for all it was worth, as when he sent off selected models as part of the Harvard display to the World Exposition in Paris (1900), in the

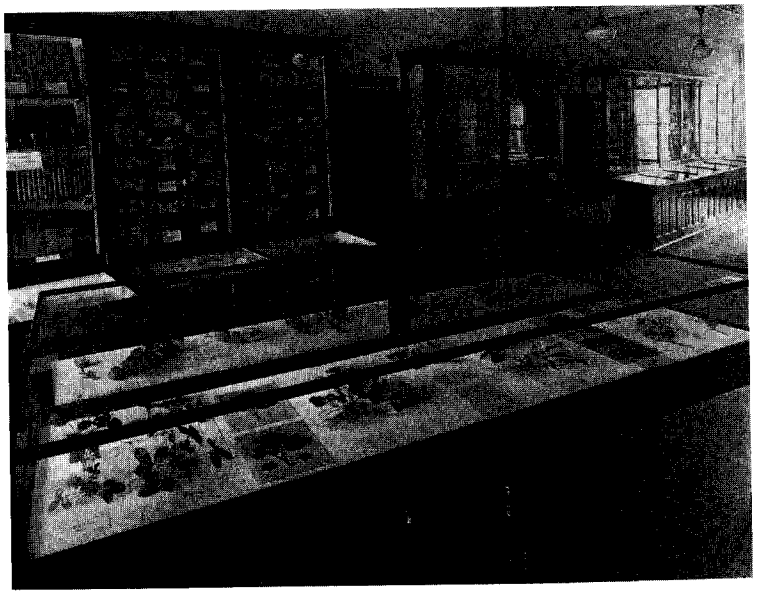

Figure 6.7. Display of Ware Collection of Glass Models in 1931 at the Botanical Museum of Harvard University. Courtesy of Harvard University Archives.

hopes that "some of the home-sick Americans in Paris may think very kindly of Harvard, if our exhibit there is a taking one."[64] Yet his assertion of the scientific utility of the Ware Collection was equally emphatic, albeit scientific, more particularly botanical, in a sense that was already disappearing when the models were commissioned. Central to this understanding were morphology, the science of appearances, and the ability to fuse vision and judgment into a single trained faculty for making sense of the pied variety of organic forms.

Goodale consistently described the Glass Flowers as models or "illustrations of types of the great classes and the subordinate groups of plants" or even as an "authoritative cabinet of type-specimens."[65] This usage is doubly perplexing. First, type specimens were usually individual plants, preserved in a herbarium, upon which the original identification of a species had been made and which served as the ultimate reference for all further description and classification. In rare cases in which such a specimen was unavailable or difficult to preserve, an illustration might serve as the type specimen, as in the case of Pierre-Joseph Redouté's celebrated images of the Liliaceae family.[66] But this would not have been the case for any of the species represented by the Blaschka models; nor is there any evidence that the models were ever used in this capacity. Second, the models were *too* accurate to be typical in the then-accepted botanical sense of representing an ideal that displayed the characteristic features of a plant genus or species, without any individuating peculiarities. In his influential *Phytographie* (1880), the Swiss botanist Alphonse de Candolle distinguished sharply between an "authentic specimen" (*échantillon authentique*) and "material representations of the true ideal type [*type idéal véritable*]"; only the latter had any taxonomic legitimacy.[67] Goodale followed this view in his own introductory botany lectures, describing the "type-flower" as an "approximation

towards perfection," and as director of Harvard's Botanical Garden, where he favored "types for the use of students instead of simple curiosities or specimens for horticultural exhibitions."[68]

How, then, were the Blaschka models to serve as "types"? Their accuracy was breathtaking, even supererogatory. The Harvard botanist Walter Deane undertook to examine the cluster of about twenty-five hundred to three thousand tiny flowers of the model of an angelica (*Aralia spinosa*) blossom with a lens and found each and every one of them to have "its five petals and five alternating stamens with long filaments."[69] It was a banality, repeated ad nauseam, that "as in Nature, no two flowers or leaves of a single plant are exactly the same, so in the glass reproduction every minute variation is followed with the greatest fidelity."[70] It is precisely in this hypertrophied accuracy that their value as models must be sought, despite the tension with prevailing notions of botanical types. Goodale intended them to be "exact fac-similes of certain typical plants," in three dimensions, and neither "conventionalized nor exaggerated," as in the case of two-dimensional illustrations. The eye of the fledgling botanist would thereby be trained in Goodale's version of morphology, "the detection of all disguises which conceal [the] identity of [the] plant," without the lazy trot of an already idealized illustration. The Glass Flowers forced students to "earn their facts" — or types — but without wetting their feet. Hence Goodale could recommend a visit to the Ware Collection in place of expeditions to gather wildflowers for Boston school classes or suggest that "excellent photographs of [models of] the principal types of flowering plants" be used for botanical instruction rather than photographs of the plants themselves.[71] The uncanny accuracy of the Glass Flowers liberated the botanist from real flowers while preserving all the features required to master morphology by the arduous, self-sufficient methods Goodale preached. The handicraft methods of the artisans

converged with nature's own, and made nature superfluous: "Their [the Blaschkas'] models are the living plants, and every flower has its separate pattern no two being exactly alike. They are not all cast in one mold."[72] The models did not simply represent nature; they replaced it.

It was partly these almost blasphemous pretensions of the Glass Flowers that excited the enmity of other botanists, among them Goodale's colleague William G. Farlow. In an 1889 letter to his former student Roland Thaxter, Farlow recounted how he had poured cold water on a Boston lady who "told me she could not imagine anything so beautiful as the models. I ventured to ask whether she did not think the plants themselves were beautiful."[73] It was no accident that Farlow and Thaxter were cryptogamists, specialists in nonflowering plants like ferns and mosses that reproduced by spores, as opposed to the flowering phanerogams that had previously dominated botany and were the chief subject matter of the Blaschka models. For Farlow and Thaxter, the Glass Flowers symbolized what they disdainfully called "Oh! *My*!" botany, at once flashy and phanerogamist. When Goodale objected to an expedition to Jamaica to gather cryptogam specimens, Thaxter was indignant: "What are glass models of phaenogams or other apparatus for hoodwinking a credulous Plutocracy as compared with the treasures we should bring to light."[74] The cryptogamists were not only envious and resentful of the funds and space lavished on the phanerogams (maddeningly apostrophized in textbooks as "the higher plants"); they were contemptuous of what they viewed to be the vulgar sensationalism of flowering plants, and the attention attracted by the Glass Flowers only deepened their antipathy. Their disdain extended to colleagues as well as to Boston grandes dames and hoi polloi. Farlow expressed relief when the Visiting Committee to the Harvard Department of Botany in 1891 "did not 'enthuse' much over the glass flowers";

he was worried that President Eliot, though a chemist, "has no real conception of botany as a science and is apt to be taken in with sensational things – as glass flowers."[75] In fact, Rudolph Blaschka had made models of cryptogams, which were to have been exhibited at the Paris Exposition, but these were at first withheld because of doubts expressed (by Farlow?) about their accuracy, and then definitively withdrawn by Blaschka himself. As Goodale explained to Eliot, "All of them are made of *clear* [glass] and do *not* represent or illustrate the peculiar Blaschka methods."[76] Those methods depended for their effect on a definition of accuracy restricted to the forms and colors of visible surfaces, best appreciated in plant parts evolved to be gaudily manifest, namely flowers.

The issues that divided the admirers and detractors of the Glass Flowers did not reduce in any simple way to popular versus scientific botany: both sides had embraced the laboratory and the microscope; both mounted museum displays; both lectured to lay audiences – though Goodale certainly outstripped Farlow as a fund-raiser.[77] Nor was the bone of contention whether botany would continue to be a "science of beauty"; fern fanciers and other cryptogamists were quite capable of going into aesthetic raptures over their specimens.[78] Rather, it was the *kind* of beauty that was at stake: showy appearances versus hidden mechanisms, a distinction with affinities too close for comfort to that between vulgarity and refinement, or between phenomena and noumena. The very word "phanerogam" derives from the Greek word *phaneros*, meaning "visible, apparent"; in this sense, flowering plants were literally sensational, phenomena ("appearances") in the root sense of the word. The art and accuracy of the models lay in the perfect simulation of appearances of the kind of plants in which the organs of botanical interest coincided with the focus of public fascination – the flowers. As the reproductive organs and essential

classificatory features of an enormous plant taxon, flowers had commanded scientific attention since Linnaeus. Yet when the Glass Models definitively became the Glass Flowers, they ceased to be scientific. Post-Darwinian phylogenetic approaches suggested that cryptogams were the most ancient plant phylum; Goodale himself had noted a trend by 1918 toward "the study of the lower instead of the higher or flowering plants, these latter being treated merely as members in a long series, and with scant consideration."[79] But the rivalry between cryptogamists and phanerogamists was not simply a matter of who could boast greater antiquity for their plants. In addition to their feminine, decorative associations (already well established in Linnaeus's time), flowers had come to symbolize the exoteric, the superficial, the epistemologically shallow, and the screamingly obvious. They lacked the depth and difficulty, the "restraint" of Marianne Moore's poem, that signed taste and truth.

Conclusion: The Perfect Copy

Although Goodale and his contemporaries admired the Glass Flowers as marvels of both science and art, they are by now outcasts in both domains. Neither botanists nor artists value extreme mimesis; on the contrary, they are discomfited by it. For the botanists, the models are too detailed to highlight the taxonomic characteristics of the plants; for the artists, meticulous verisimilitude and mismatch of form to medium signal kitsch. Connoisseurs of glassware appreciate the technical achievements of the Blaschka models, but as an artisanal dead end that inspired no styles or schools. Insofar as poets and artists have invoked the Glass Flowers, it is as metaphors that point beyond the things themselves. The fact that thousands of tourists come to gawk at the models every year does not improve their standing in the Republic of Letters. Superior people do not visit the Glass Flowers.

Yet the Glass Flowers are capable of mustering passionate supporters, not all of whom have a professional interest in the history of botany or glassworks. Their qualities as simulacra cannot be the whole explanation; equally exact floral models in wax have failed to attract anything like the following enjoyed by the Glass Flowers. I have suggested that certain other aspects of the Blaschka models – the quixotic dedication to the medium of glass and the painstaking efforts they at once embody and propagate – may rescue them from dusty silence and turn them into things that talk. Doubtless there are other aspects of their communicativeness. They have in common with other hallowed things a kind of real presence. Pilgrims make long, arduous journeys to see relics close-up; scholars and art lovers go to considerable expense and trouble to visit archives and museums where they can behold objects firsthand; friends of the great sequoias are not content with Sierra Club photographs. The same holds for the Glass Flowers, but for reasons that are more difficult to explain. Relics exert their virtue only close-up, often by touch; a slide of a Cézanne does not do justice to the details of brush stroke and paint modeling; you cannot smell a sequoia photograph or be dwarfed by it. But the Glass Flowers were never meant to be smelled or touched or even peered at too closely. They are pure appearance, and for pure appearance a good photograph, itself pure appearance, ought to suffice. Why, then, do they exude and demand real presence?

In the past century or so, a very few of the Glass Flowers have been allowed to travel, most recently to exhibitions in New York (1976) and Avignon (2000), where they are displayed singly, like framed paintings by illustrious artists (color plate VI). But the curious museumgoer must travel to Cambridge to see the collection in its entirety, spread out in rigid fragility in a room with warnings about setting off dangerous vibrations. It is not just the hold-your-breath fragility of the Glass Flowers that necessitates a

trip to see them in three dimensions. Although they are representations themselves, they defy representation. A photograph of the glass model of a daylily or a strawberry plant looks exactly like a photograph of the daylily or strawberry plant in your garden. The Glass Flowers are perfect copies, but for just that reason they are not perfect plants. One of the daylilies has begun to shrivel; there is a fungus nibbling at the strawberry leaf. The wonder of the Glass Flowers is not the idealized beauty of the finest botanical illustrations, or that of the prizewinning garden overflowing with a plenitude of vegetable colors and shapes, or even that of the consummate illusion of naturalistic art. It is the wonder of the copy that itself cannot be copied, which somehow is more authentic than the original.