

ARS VITRARIA: GLASS IN THE METROPOLITAN MUSEUM OF ART

THE METROPOLITAN MUSEUM OF ART

CONTENTS

4 INTRODUCTION

Stefano Carboni, Associate Curator
Department of Islamic Art

THE DEPARTMENTS

8 ANCIENT NEAR EASTERN ART

Joan Aruz (JA), Curator
Elisabetta Valtz Fino (EVF), Associate Curator

11 EGYPTIAN ART

Susan Allen (SA), Senior Research Associate; Marsha Hill (MH),
Associate Curator; Diana Craig Patch (DCP), Senior Research Associate;
Catharine H. Roehrig (CHR), Curator
Wallace Curatorship in Egyptology: Christine Lilyquist (CL), Lila Acheson Wallace
Research Curator in Egyptology

18 GREEK AND ROMAN ART

Christopher S. Lightfoot (CSL), Associate Curator

25 ASIAN ART

James C. Y. Watt (JCYW), Brooke Russell Astor Chairman
Zhixin Jason Sun (ZJS), Associate Curator

28 ISLAMIC ART

Stefano Carboni (SC), Associate Curator

33 MEDIEVAL ART AND THE CLOISTERS

Timothy B. Husband (TBH), Curator

40 ROBERT LEHMAN COLLECTION

Linda Wolk-Simon (LW-S), Associate Curator

45 EUROPEAN SCULPTURE AND DECORATIVE ARTS

Jessie McNab (JMcN), Associate Curator

51 ARMS AND ARMOR

Donald J. LaRocca (DJL), Curator

52 MUSICAL INSTRUMENTS

Herbert Heyde (HH), Associate Curator

53 AMERICAN DECORATIVE ARTS

Alice Cooney Frelinghuysen (ACF), Anthony W. and Lulu C. Wang Curator

60 MODERN ART

Jane Adlin (JA), Assistant Curator

66 TECHNICAL EXAMINATION AND CONSERVATION OF GLASS

Lisa Pilosi, Conservator, and Mark T. Wypyski, Associate Research Scientist
Sherman Fairchild Center for Objects Conservation

DIRECTOR'S NOTE

In the galleries of the Metropolitan Museum, visitors encounter works of art organized by culture, period, and geographical distribution. This encyclopedic approach is by far the best one for an art museum, but it does have a few disadvantages. Because individual media, such as metal, pottery, and glass, are dispersed throughout our vast building, anyone who wishes to obtain a broad understanding of the art-historical development of one of these materials must embark on a sort of treasure hunt, progressing from the galleries of Egyptian and ancient Near Eastern art to those devoted to Greek and Roman art, and so forth, often culminating in the Lila Acheson Wallace Wing for the most recent manifestations of a particular art form.

The present *Bulletin* addresses this problem by creating a virtual tour—which, of course, cannot replace a visit to the Museum—of some of the most significant holdings in a single medium: namely, glass (and, in the early period, related materials such as glassy faience). The objects illustrated and discussed herein were acquired between 1874 (with the famous Cesnola Collection) and 2000. That they include gifts from some of our greatest patrons—Henry G. Marquand; Edward C. Moore and his son, Edward C. Moore Jr.; Mrs. Samuel P. Avery; Theodore M. Davis; J. Pierpont Morgan; Mr. and Mrs. H. O. Havemeyer; and Robert Lehman—bears witness to the widespread appreciation of and respect for this branch of the decorative arts.

Glassmaking may be regarded by some as little more than a useful craft, which, thanks to technological advancements ranging from plate-glass windows to fiber optics, has ameliorated the quality of life on every continent. But one

cannot ignore glassmaking's five-thousand-year history of artistic achievement, radiating from Mesopotamia and Egypt to Europe, Asia, and the New World. The title of this *Bulletin*, *Ars Vitraria* (Latin for "the art of glass"), is borrowed from a seminal glassmaking manual by the German alchemist Johann Kunckel, *Ars vitraria experimentalis* (1679), which was itself full of borrowings from previous manuals and generations of glassmakers. The history of the myriad forms and techniques invented by these ingenious artist-technicians is followed step by step in these pages—or, more precisely, it is covered by leaps and bounds, given the small size of the publication, which nonetheless reflects the contributions of twelve curatorial departments in addition to the Sherman Fairchild Center for Objects Conservation.

The opportunity to produce a *Bulletin* on glass is afforded by the forthcoming installation, in October 2001, of "Glass of the Sultans," a collaboration between the Metropolitan Museum and the Corning Museum of Glass. This first-ever full-scale exhibition of the stunning glass objects produced in the Islamic world is co-curated by Stefano Carboni, associate curator in the Department of Islamic Art, who also coordinated the departmental efforts for this *Bulletin*. We are delighted that its publication coincides as well with the triennial conference of the Association Internationale pour l'Histoire du Verre, which returns to the United States after an absence of twenty-one years, with sessions to be held both at the Metropolitan and in Corning.

Philippe de Montebello
Director

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On the cover: Roemer, Dutch, early 17th century (see p. 46)
Back cover: Detail of Roemer

INTRODUCTION

Thanks to its versatility, its wide range of attainable colors, its natural translucency, and even its durability—which is much greater, especially over time, than we tend to think—glass has stimulated the creativity and skill of glassmakers engaged in practical as well as artistic pursuits for many centuries and in many different cultures. The following selection of masterpieces, rarities, and historical milestones from the collections of The Metropolitan Museum of Art provides an overview of the infinite artistic possibilities of this extraordinary material.

The fascination with glass is due in part to its unique molecular structure: though hard and solid at normal ambient temperatures, its atoms defy the ordered crystalline arrangement of most solids and retain instead the random organization of a liquid. Various described from antiquity to the present as a “melted stone,” a “solid liquid,” and, in the language of modern physics, a “supercooled liquid” or an “amorphous solid,” glass invariably begins as a mixture, or batch, of solid raw ingredients. When very high heat is applied to the batch, it melts and becomes fluid. Outside the furnace, as its temperature decreases, it becomes increasingly viscous and eventually becomes rigid. The solidifying process takes place in a more gradual fashion than it does with other materials, such as metal, which crystallize suddenly. This “slow freeze” allows the glassworker to inflate, pull, and twist the cooling mass in all directions, to shape it into endless forms, and then to decorate those forms while they are still soft with various tools (hot-working; see fig. 1). Though gradual in scientific terms, the cooling takes only a matter of minutes, and glassmaking at its artistic best is a fast, sometimes frantic

Figure 1
Three examples of hot-working, performed by William Gudenrath in the Studio of the Corning Museum of Glass: inflating a gather of glass; twisting glass that has been dipped into a ribbed mold, so as to create a spiral pattern; and threading soft white glass around a darker bubble



endeavor that requires a good eye and great dexterity. Once it has hardened, the glass can be worked in more leisurely fashion by the lapidary technique—as if it were made of marble or a gemstone—with rotating wheels, diamond or other hard-stone points, and drills (cold-working).

One of the “arts of fire” (along with ceramics and metalworking), glassmaking has been part of everyday life for over two millennia. Though extremely serviceable as tableware and as a means of storing different kinds of substances, including the valuable perfumes, essences, and spices transported on the trans-Eurasian Silk Road, glass was

also, in its own right, one of the most precious and sought-after products for trade and gifts. As such, glass objects found their way to China and Japan from the Roman provinces and from Iran throughout the first millennium A.D. Already in this early period, glass was indispensable to technological and scientific progress, and ever since it has been used in the manufacture of lighting and chemical apparatus, pharmaceutical vessels, windows, mirrors, optical devices—such as lenses for spectacles, telescopes, microscopes, and cameras—cookware, and, most recently, fiber-optic cables.

The process of glassmaking—whether the final product is a soda bottle or a several-foot-tall Dale Chihuly chandelier temporarily suspended over the Campo della Salute in Venice (fig. 2)—begins in the fierce heat required to produce red-hot molten glass, either from scratch or by making use of varying amounts of cullet, or recycled glass, as a catalyst to accelerate melting. For millennia, the essential ingredient of glass has been silica, which is introduced to the batch in the form of sand, quartz pebbles, or flint. It would be nearly impossible to melt the silica, however, without the presence of a flux, which lowers the melting temperature by hundreds of degrees. Most fluxes are alkalis, such as potash (potassium oxide) and soda (sodium oxide). These were once available in Egypt from the naturally occurring mineral natron and have been obtained elsewhere by burning plants or wood into ash. Another basic component of glass is lime, or calcined limestone, which can be present in the sand or in the flux. Lime lends stability to the batch by reducing solubility and preventing crizzling, a type of corrosion (see p. 68), in the finished product, but its utility became known only in the seventeenth century, when glassmakers started including it deliberately. Lead, which exists in significant concentrations in ancient and later Chinese glass, can act as both a flux and a stabilizer. It was the ability of a lead oxide to enhance the brilliance of colorless glass, however, that revolutionized the European glass industry when George Ravenscroft, in late-seventeenth-century England, began marketing his lead glass, commonly referred to as crystal.

Although glass owes its “natural” greenish appearance to trace amounts of iron in the sand, glassmakers have worked since almost the beginning either to alter that color or to eliminate color entirely. That this has been possible can again be attributed to the random molecular structure of glass, which allows innumerable metallic oxides to be dissolved in it. The most common oxides are those of copper, cobalt, and iron, which produce all shades of blue and green glass. Some colors at the warmer end of the spectrum—red, yellow, orange—are more difficult to produce and require more



Figure 2
Campo della Salute
chandelier by Dale
Chihuly (American,
b. 1941); Venice, Italy,
1996

elaborate techniques (see the goblet on p. 48), but, ultimately, an extraordinarily wide range of colors has been achieved. Some oxides, such as those of antimony and manganese, have been used to decolorize glass (hence the term “glassmaker’s soap” in the trade) so as to imitate rock crystal, one of the most precious materials for luxury objects since ancient times. The imitation of opaque and varicolored hard stones such as striped agate and jasper has also been a preoccupation of glassmakers through the ages, who have had to figure out how to counteract one of the most common properties of glass—its translucency. Many opacifiers, which interfere with the transmittal of light through the material, have thus been developed.

Although the origins of glassmaking are obscure—it may have been an accidental discovery related to the production of faience or to metallurgy—there is little doubt that intentional glassmaking first arose in western Asia in the mid-third millennium B.C. The output was restricted to beads, amulets, inlays, and the like for about a thousand years. From the mid-second millennium on, glass vessels and other objects were made by core-forming, casting, fusing, and slumping, as described in the sections of this



Figure 3
Engraving by Giuseppe Maria Mitelli (1678): the female figurine on the end of the blowpipe declares, “I am made of glass, and I was blown,” while onlookers remark that such objects are difficult to make and easy to break

Bulletin concerned with the ancient world. The turning point for this material in terms of its practicality and accessibility, however, occurred in the first century B.C., on the Syro-Palestinian coast in the eastern Mediterranean. The use of a hollow tube—the blowpipe—to inflate molten glass like a soap bubble was a true technological breakthrough that allowed for mass production and made an otherwise time-consuming and expensive product more affordable and widespread. This innovation can be better appreciated when one thinks that a simple vessel—a bottle, for example—was usually created before this time by laboriously gathering glass around a core that was eventually discarded, whereas glassblowing allowed the same vessel to be shaped in less than a minute.

Glass could now be blown either freely at the end of the blowpipe; into a mold that determined the object's dimensions, shape, and decorative surface patterns; or into a beaker-shaped dip, or pattern, mold. Dip molds impressed the surface patterns on the parison (gather of molten glass) at the end of the pipe but allowed the glassworker to establish the object's form and size by blowing once the parison was removed from the mold. With these advances, the decorative possibilities for glass had become endless, the limit being the craftsman's own creativity, even though tradition—often family tradition, as can be observed, for example, in the venerable Venetian glass industry—played an important role in the continuity of certain shapes, patterns, and techniques. The Roman provinces of the eastern Mediterranean, which would become Islamic in the seventh century A.D., were a leading glassmaking region throughout the medieval period, though developments in northern Europe, such as the rise of “forest glass” (potash-rich wares that resulted from the burning of inland plants for alkali, when production facilities began to emerge far from the cities and coasts), are also of great interest. Finished objects, raw materials, cullet, and recipes traveled from the Islamic lands to Europe, Asia, and Africa until, over the course of the fifteenth century, Venice established an effective monopoly on glass, which lasted until the eighteenth.

As for the past two centuries, it is difficult even to think of glassmaking without considering its role in the industrial revolution and its practical uses (see fig. 4). Partly in response to this conspicuous association, however, a number of glass factories and individual glassmakers began to isolate their medium in purely artistic terms. The change in emphasis took place all over Europe, especially in Venice, France, and Bohemia, but also in England, Ireland, Spain, Germany, Russia, and, with the founding of twentieth-century artistic movements, Scandinavia. Quickly catching up with the Old World, American glass played a prominent role in the development of a distinct artistic awareness in the decorative arts. Indeed, innovators in the United States can be credited almost exclusively with the birth of the studio-glass movement (see p. 60). Today, although internationalism would probably best describe artistic trends in glassmaking—since artists have a tendency to learn techniques at various schools at home and abroad and later to elaborate their own styles wherever they settle—American practitioners, centers, and sponsorship are at the forefront of contemporary glass and provide strong support for future exciting developments in the field. The galleries of the Metropolitan Museum are now, and will continue to be, an ideal place to view these developments in the deepest, broadest art-historical context.

Stefano Carboni

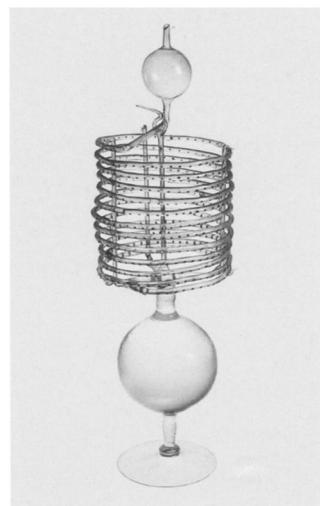


Figure 4
A closed-glass liquid thermometer, invented at the Accademia del Cimento in Florence (1657–67) and blown in the academy's own furnace

Ancient Near Eastern glass in the Metropolitan Museum spans well over two millennia and a vast geographic distance, from the eastern Mediterranean to the Indus Valley. The technology for the making of glass vessels appears to have developed in the sixteenth century B.C. in the area of northern Mesopotamia and Syria encompassing the Hurrian-Mitanni kingdom. During the Late Bronze Age (16th–13th century B.C.), luxury vessels in shapes used for pottery were produced by the core-forming technique, in which a core of clay and other materials—later removed to produce the cavity—was covered with molten glass or, in rare instances, with cold mosaic elements that were fused together on the core. Most of the excavated examples have been found in temples, elite residences, and burials. One significant Near Eastern piece of this period, which may have belonged to Thutmose III's Syrian bride, is a goblet of marbled glassy faience made by a variation on the core technique so as to resemble veined stone (acc. no. 26.7.1175; see p. 12).

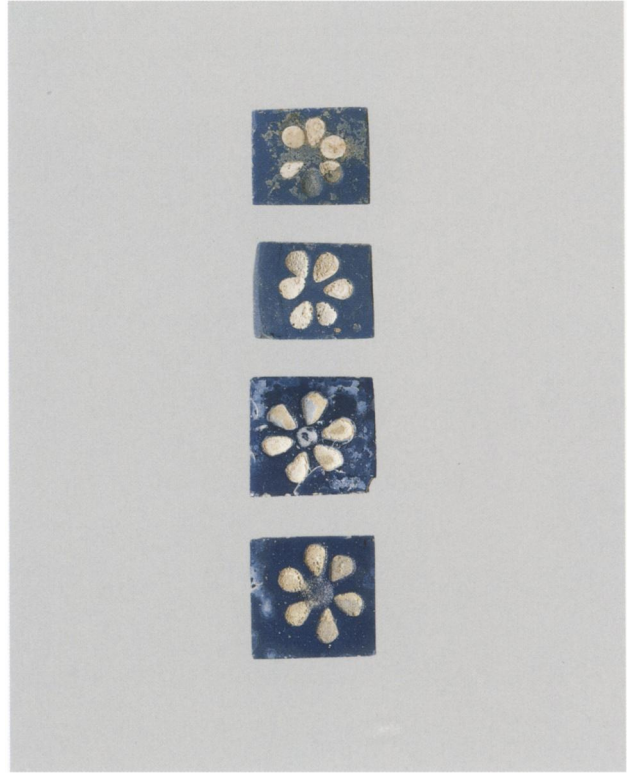
Both material evidence and literary evidence—in the form of cuneiform texts describing the ritual and scientific preparations for glassmaking—attest to the survival of this craft after a hiatus in which great empires disappeared and reemerged in the Near East. During the Assyrian Empire (9th–7th century B.C.), glass production centered around the royal capital of Nimrud and probably involved Phoenician craftsmen, who were expert at inlaying glass into ivories and painting on glass. The most elaborate vessels, which imitated luxury metal and stone wares, were probably cast in the lost-wax technique and finished by grinding, drilling, and polishing. (See p. 19 for an additional Near Eastern vessel of this period.)

After the fall of Assyria, Near Eastern glassworkers may have settled in Rhodes, possibly launching the great core-formed-glass industry that flourished in the Mediterranean during the Achaemenid Empire (6th–4th century B.C.). In the wake of Alexander the Great (r. 336–323 B.C.), and with the formation of the Roman, Parthian, and Sasanian empires, extensive trade further strengthened the industry. In the mid-first century B.C., the revolutionary technique of glassblowing was invented in the Syro-Palestinian region; both free-blown and mold-blown vessels were subsequently produced. Parthian and Sasanian glassware (2nd century B.C.–7th century A.D.) was often embellished with cut facets, blobs and trailed strings of glass, and molded designs. In addition to these luxuries for the court or the tomb, glass was employed for architectural decoration, especially in the palaces of Sasanian rulers. JA



FRAMED INLAY PLAQUES *left*

Syria (probably Arslan Tash), 8th century B.C. Glass, vitreous material, and copper alloy. Average w. $\frac{3}{4}$ in. (1.8 cm). Fletcher Fund, 1957 (57.80.18a–i)



INLAY PLAQUES *right*

Mesopotamia (Nimrud, Fort Shalmanasar), 8th century B.C. Glass and vitreous material. Average w. $\frac{5}{8}$ in. (1.6 cm). Excavated by the British School of Archaeology in Iraq. Rogers Fund, 1962 (62.269.15a–d)

Plaques such as these provide evidence for the reemergence of glassmaking in western Asia at the beginning of the first millennium B.C. Inlays of this type—probably the work of Phoenician or Syrian ivory carvers—have been found in Mesopotamia and the Levant. Wooden furniture made for the wealthy Assyrian court of the eighth century B.C. featured applied decoration of both ivory and glass. The colorful glass pieces, inlaid into ivories as well as directly into wood, were meant to imitate precious stones.

In the plaques from Nimrud (above right), the six-petal rosettes are visible only on the upper face of the cobalt blue squares, which were possibly designed to be inlaid into an ivory object. The small blue squares of the Arslan Tash group (above left) were set into larger, reddish glass squares—now oxidized to green—which were then mounted in copper-alloy frames and probably fixed onto wooden furniture. Here, the rosettes penetrate the thickness of the blue squares and are visible on both sides. According to laboratory analysis of the plaques, the opaque white rosettes consist in both cases of silica, calcium, and antimony, which seem not to have totally fused into a true glass consistency. Because of the use of two different vitreous materials together, the technique of manufacture has yet to be resolved. EVF



VESSEL WITH TWO HANDLES

Mesopotamia or Iran, Sasanian period, 4th–5th century A.D. Blown and wheel-cut glass. H. 13 in. (33.1 cm). Fletcher Fund, 1964 (64.60.1)

This elegant vessel has a tapered body, a high, narrow neck, a funnel-like mouth with a molded rim, and two twisted coils of glass for handles. The body, made of blown, transparent glass of a pale blue-green hue, is covered up to the shoulder with wheel-cut hexagonal facets. The honeycomb motif—the preferred decorative pattern in Sasanian glassware—creates a reflective surface. In this case, golden iridescence and opaque beige corrosion, which are the results of weathering, obscure most of the surface.

The vessel was possibly used for some kind of libation involving the flowing of liquid from a pierced hole in the bottom. The nearly perfect state of preservation suggests that it came from a burial. Glass vessels have often been found in funerary contexts—but also in dwellings—that are dated to late Parthian and Sasanian times. Excavations in Mesopotamia have revealed active glassmaking centers of the Sasanian period that were producing vessels similar to this one around the fourth or fifth century A.D. EVF



FACETED BOWL

Iran(?), Sasanian period, 5th–7th century A.D. Blown and wheel-cut glass. H. 3⅞ in. (7.9 cm). Rogers Fund, 1959 (59.34)

This hemispherical bowl was made either by blowing molten glass into an open mold or by free-blowing; subsequently, four rows of oblong-to-round facets were wheel-cut and polished. The thick, pale green glass has gained extensive iridescence through weathering.

Faceted bowls such as this one are characterized by uniformity of shape, size, and arrangement of their facets in four or five rows. They represent the most widespread type of late Sasanian glass vessel, found in excavations of Mesopotamian and Iranian sites dating to the fifth, sixth, and seventh centuries A.D. Some examples—probably carried along the Silk Road to the Far East by Persian merchants and traveling embassies—have been found in Japanese contexts, namely in the sixth-century tomb of the emperor Ankan and in the Shōsōin Treasure at Nara, which was assembled by the emperor Shōmu in the eighth century. EVF

EGYPTIAN ART

The most beautiful and well-preserved glass before the period of the Roman Empire is from Egypt, yet Egyptians did not invent glass. They applied a glassy layer to stones such as quartz and steatite in the prehistoric culture of the fourth millennium B.C.; first made a vitreous material called faience in about 3000 B.C., at the very beginning of their historic era; and in the Pyramid Age of the mid-third millennium manufactured the vitreous fabric known as Egyptian blue. But from all evidence extant today, credit for intentional glassmaking must be given to the ancient Near East, in the geographical area now comprising northern Iraq and eastern Syria. A large royal group dating to the second half of the fifteenth century B.C. and represented by the pieces on page 12 has only recently been appreciated for its contribution to the understanding of the origins of glassmaking and the introduction into Egypt of this “melted stone” (as one of the hieroglyphic terms for glass reads).

To what extent and how early raw glass was made in Egypt are questions currently under scrutiny. In any event, glassworking—that is, the manufacture of objects from raw glass, which itself could have been imported—was already well established there by the fifteenth century B.C., as indicated by the brilliant color and superb craftsmanship of numerous vessels, small figures, and inlays. Initially perhaps a royal monopoly, glassworking probably occurred more widely in the later New Kingdom. During the Third Intermediate period (1070–712 B.C.), activity diminished, although some vessels and, more frequently, eye inlays and decorative inlays for statuary, coffins, and jewelry were produced; a broadly defined transitional material termed glassy faience, which had been known since the late Middle Kingdom, grew increasingly popular for small sculpture and luxury items. By the second half of the sixth century, there are signs that the glass industry had been reenergized. The nature of Egypt’s, particularly Alexandria’s, famed glass production during the Ptolemaic and Roman periods is not well understood, but Egyptian glassmakers touted the unique suitability of local ingredients for fine colored products, and inlays are considered to have been an Egyptian specialty in the Mediterranean world.

From private collections and from its own excavations at Lisht, Malkata, and Kharga Oasis, the Museum has assembled a wide range of artworks and other glassy materials that illuminate the phases outlined above: small sculpture, inlays, beads, opaque core-formed and transparent blown vessels, and technical debris demonstrating manufacturing methods and experiments. CL/MH



FOOTED JAR, LOTIFORM CHALICE, AND BUTTON-BASED GOBLET

Left: Egyptian, New Kingdom, Dynasty 18, reign of Thutmose III, 1479–1425 B.C. Vitreous material and gold foil. H. 3½ in. (8.9 cm). Fletcher Fund, 1920 (26.8.34). Center: Egyptian, New Kingdom, Dynasty 18, reign of Thutmose III, 1479–1425 B.C. Glass and gold foil. H. 3 in. (7.5 cm). Bequest of Lord Carnarvon, 1923 (23.9). Right: Near Eastern, mid-15th century B.C. Glassy faience and gold foil. H. 4 in. (10.2 cm). Purchase, Edward S. Harkness Gift, 1926 (26.7.1175)

These three vessels, all believed to come from the tomb of Thutmose III's three foreign wives in the Wadi Qabbanat el-Qirud at Thebes (ca. 1425 B.C.)—two of them are inscribed with the king's name—demonstrate a variety of vitreous technologies. The high-necked jar on the left is made of an unusual material somewhere between faience and glass. The goblet on the right is of glassy faience and, according to its shape and to lead-isotope analyses, was imported from the Near East. The lotiform chalice in the center is true glass, its color, fabric, and shape showing it to be the product of an Egyptian craftsman.

The Theban tomb in question also yielded an astounding array of glass inlays and beads used in jewelry. Their colors were achieved by the addition to the glass mix either of copper—as with the turquoise blue chalice in the center—or of cobalt, a colorant prized at Mycenae, in Mitanni, and no doubt in Assyria. Altogether, these vessels, inlays, and beads form the largest corpus of early glass from Egypt, dating to that point when the technology of intentional glassmaking arrived in Egypt, undoubtedly by means of foreign craftsmen. CL



FOOTED CUP *left*

Egyptian, New Kingdom, Dynasty 18, reign of Amenhotep III, ca. 1390–1352 B.C., or slightly later. Glass. H. 2¾ in. (7 cm). Purchase, Edward S. Harkness Gift, 1926 (26.7.1178)

SLENDER FLASK WITH HANDLE *right*

Egyptian, New Kingdom, later Dynasty 18, ca. 1400–1295 B.C. Glass. H. 6⅞ in. (17.5 cm). Purchase, Edward S. Harkness Gift, 1926 (26.7.1176)



Glass vessels in ancient Egypt were often modeled after vessels originally made in other materials. This slender flask of turquoise glass was copied from an imported pottery “spindle bottle” of the type that Syrians are depicted carrying in contemporary Egyptian tomb paintings, actual examples of which would most likely have contained some sort of resin. The flask was core-formed and finished by hand, with the strap handle applied separately. The elongated, ovoid body and slender neck were decorated with finely executed zigzags of dark blue and white glass. The handle is embellished with repeating bands of dark blue, yellow, and white.

The footed cup was closely copied from a stone prototype of the same period. Cups with three ribs are not known in alabaster before the reign of Amenhotep III (1390–1352 B.C.), and this glass version may therefore date from that period or slightly later. It may have been formed over a mold, the ribs were created with a tool while the glass was still soft, and the pedestal foot was applied separately. The undecorated vessel relies on the sophistication of its form and the clear, bright turquoise color for its pleasing effect. Tomb scenes suggest that such vessels were used for dispensing perfumed ointments to guests at banquets. SA



VASE IN THE SHAPE OF A POMEGRANATE

Egyptian, New Kingdom, Dynasty 19–20, ca. 1295–1070 B.C. Glass. H. 4¾ in. (12 cm). Purchase, Edward S. Harkness Gift, 1926 (26.7.1180)

Egyptians had been imitating organic forms in vessels of all materials since prehistoric times. The pomegranate, however, did not arrive in Egypt until the beginning of the New Kingdom, when it was probably brought back from western Asia during the military campaigns of the early Eighteenth Dynasty. While the fruit may initially have been available only as an import, pomegranate trees were soon planted in Egyptian gardens. A silver pomegranate-shaped vessel was included in the funerary offerings to Tutankhamun (r. 1336–1327 B.C.).

When this small vessel was purchased in Cairo, it was said to have come from a glass workshop discovered near Akhmim

in Middle Egypt in 1912. The attributes of the fruit served as the point of departure for an elegant, stylized shape with a long, slender neck and scalloped rim. Pomegranates in nature can range from green to yellow to red, so the choice of yellow glass was not unrealistic.

The body of the vessel was core-formed. The nine calyx tips were made while the glass was still soft, by pulling the rim up and out and cutting it into scallop shapes. This vase may have contained a precious oil or perfume, or perhaps pomegranate juice, which was often added to wine. **SA**



FRAGMENT OF A FIGURE VASE

Egyptian, New Kingdom, probably second half of Dynasty 18, ca. 1427–1295 B.C. Glassy faience. H. $\frac{3}{4}$ in. (2 cm). Theodore M. Davis Collection, Bequest of Theodore M. Davis, 1915 (30.8.164)

The rough inner surface of this fragment suggests that it was part of a small figure vase depicting a mother holding an infant in a cloth sling high on her back, its arms resting on her shoulders. The woman was leaning slightly forward to balance the child's weight, thus allowing its head to emerge from the surface of the vase. In Egyptian art, foreigners are usually the ones who are depicted carrying children in slings, but at least two pottery vessels and an agricultural vignette in the Theban tomb of Menna indicate that Egyptians used the same method of transport. This child appears to have a lock of hair at the right side of its head (not shown), suggesting that both child and mother were Egyptian. Motherhood, symbolized by either humans or animals, was a common theme for cosmetic vessels. This skillfully crafted figure vase probably contained either an expensive perfumed oil or a precious liquid used for medicinal purposes.

The vase was made of a compact glassy material with a discrete surface layer. The material is best described as glassy faience, a substance first produced by Egypt's faience workshops in the late Middle Kingdom but known only rarely before Dynasty 22 (ca. 945–712 B.C.). CHR



COSMETIC BOX

Egyptian, Dynasty 26–early Ptolemaic period, ca. 664–300 B.C. Glassy faience. H. $3\frac{3}{4}$ in. (9.5 cm). Purchase, Lila Acheson Wallace Gift, 1999 (1999.213)

In ancient Egypt, the demand for expensive unguents led to the creation of many elegant containers. The decoration of this box imitates a floral capital from a column that would have stood in a temple court. Most popular in the Ptolemaic period, such capitals merged several types of flower into a single motif. Small holes in the lid and the base once held a peg that allowed the lid to pivot open. The three interior compartments probably held ointments, which discolored the surface over time. The traditional method of closure for boxes—a string looped between two knobs—is recalled here in the nonfunctional protuberance seen at the top of the lid.

The piece has a blue-green matte finish, and a small area of ancient damage reveals a compact matrix of even color, indicating that the body is glassy faience. Used regularly in the Third Intermediate period, this material was most popular in the Late and Ptolemaic periods for the manufacture of *shabtis* (funerary statuettes), containers, and other small objects. This container was formed in a mold, but the floral details and the interior's small partitions were defined after the faience had partially dried. DCP



INLAYS AND SHRINE ELEMENTS

Egyptian, Dynasty 30–Ptolemaic period, ca. 380–30 B.C. Glass. H. (each drum) 1 $\frac{1}{8}$ in. (4.1 cm). Rogers Fund, 1921 (21.2.2)

This fanciful arrangement indicates the range of a group of fine glass inlays and shrine elements that were purchased together. Included are monochromatic figural elements (human or divine), monochromatic and mosaic hieroglyphic and decorative elements, and red column drums, along with other types of material not pictured: bits of gilded plaster, long bronze rods for threading the drums together, large bronze sockets, and bronze bolts in the form of the hieroglyphs for door bolt and for union. While many elements are clearly related, their variable size, style, and degree of finish suggest that the group actually represents an accumulation of material. The face inlays are of the type termed Sebennyitic-Ptolemaic, and minute mosaic designs indicate a similar date.

Wooden shrines densely inlaid with figural, hieroglyphic, and decorative glass elements are known from the late sixth century B.C. onward, while glass hieroglyphs appear on fourth-century wooden coffins and glass figures adorn Ptolemaic and later cartonnage and plaster mummy covers. Inlay elements might be placed in separate cells or be contiguously adhered on a common background. Drums of glass, faience, and Egyptian blue from small shrine columns have been found at numerous sites in Egypt of the Ptolemaic period or later and at Delos in Greece; apparently, red and blue sections would ideally have alternated with gilded wood sections. MH



STATUETTE OF THE GODDESS TAWERET

Egyptian, Ptolemaic period, 332–30 B.C. Glassy faience. H. 4¼ in. (10.8 cm). Purchase, Edward S. Harkness Gift, 1926 (26.7.1193)

In all likelihood, this statuette represents the goddess Taweret, whose domain was the protection of pregnant women, especially during childbirth. Her grotesque image, intended to frighten away demons and other deadly creatures, combines human, hippopotamus, crocodile, and lion attributes. The post on her head probably supported a metal crown in the shape of a sun disk, surmounted by either feathers or horns. The stylized symbol under her front paws can be best interpreted as the tyet amulet, a symbol of the mother goddess Isis. Although Taweret was worshiped in both secular and sacred settings, this statuette's almost perfect condition, exceptional craftsmanship, size, and iconography suggest that it was created for a temple—possibly for the “birth house” where this goddess was linked with Isis.

In the past, the piece was identified as true glass. While it is difficult to identify the material precisely, pooling of glaze around the feet and the slightly grainy structure visible in a few places strongly argue for glassy faience. Possibly the overall form was created in a mold, but details of the head and extremities, which convey the deity's power and intimidating nature, must have been modeled by hand. The pale blue color of the glaze assists in assigning a Ptolemaic-period date. DCP



FLORAL PLAQUE

Egyptian, Roman period, late 1st century B.C.–1st century A.D. Glass. W. 2⅞ in. (6.5 cm). Purchase, Edward S. Harkness Gift, 1926 (26.7.1249)

Glass plaques were employed in the Hellenistic and Roman Mediterranean world to decorate walls, screens, and furnishings. This particular fresh and exuberant floral type was popular chiefly in Egypt and was probably manufactured in Middle Egypt. Panels of this sort, which are thought to have originally been up to six inches tall and just under three inches wide, exhibit a characteristic set of vegetal motifs. While correlations to actual species are difficult to make, three nelumbo lotus flowers can be identified at the bottom of this plaque, and what appear to be two grape clusters are recognizable at either side of the fanlike group of leaves in the center.

The plaque was made by fusing cross sections of mosaic canes, colored strips, and chips of bluish green glass, with an added backing of chips and waste glass for thickening. The front was then ground and polished to smoothness. The slight translucency of the matrix glass is an effect of back-lighting and would not have been apparent when the panel was set in place. MH

GREEK AND ROMAN ART

The Metropolitan Museum of Art possesses one of the world's finest and most comprehensive collections of ancient glass. The holdings illustrate many of the processes, skills, and decorative elements that were employed in the manufacture of glass objects in Greece and Rome. Vessels are the most common and well-known products of the ancient glass industry, since, having been deposited in tombs, they have often survived intact. However, glass was also fashioned into a wide range of other items, including tesserae for mosaics, inlays and revetment plaques, jewelry, utensils, windowpanes, and mirrors.

The making of glass vessels was introduced into the Greek world in the late eighth century B.C. by the Phoenicians, who produced bowls (open forms) and containers (closed forms) by carving blocks of cast, usually decolorized glass as if it were semi-precious stone. The Phoenicians also made vessels by gathering molten glass around cores of mud or clay, and it was largely this technique that was adopted by Greek craftsmen. In Classical and Hellenistic times (480–31 B.C.), the production of glass vessels was dominated by the core-formed industry, which displayed a marked conservatism with respect to shape and decoration. In the Hellenistic period, however, glassworkers in the eastern Mediterranean also began to experiment with new shapes, modes of manufacture, and types of decoration. This experimentation culminated in the invention of glassblowing in the Syro-Palestinian region in about 50 B.C.

At a slightly later date, probably during the reign of the emperor Augustus (27 B.C.–A.D. 14), glassworkers began to move from the Near East to Italy and set up new production centers in Rome and other Western cities, where they continued their technical innovations. While glassblowing allowed plain, utilitarian vessels to be mass-produced, growing familiarity with the blowpipe also gave glassworkers the ability to deviate from standard shapes, thereby creating a whole new range of luxury goods and tablewares. In addition to applying trails and colored blobs of glass, Roman craftsmen adapted decorative techniques, such as engraving, cold-painting, and gilding, from other media. Finally, in late antiquity, the skill developed of carving glass vessels with openwork designs—a distant echo of the methods first used by the Phoenicians over a millennium earlier. ^{CSL}



ALABASTRON *left*

Probably Phoenician, late 8th–6th century B.C. Found in Cyprus. Cast glass. H. 7 in. (17.9 cm). The Cesnola Collection, Purchased by subscription, 1874–76 (74.51.312)



ALABASTRON *right*

Mesopotamian, 7th–6th century B.C. Cast glass. H. 4¾ in. (12.1 cm). Gift of Henry G. Marquand, 1881 (81.10.309)

Although the making of glass vessels first arose in Mesopotamia and Egypt in the Late Bronze Age, during the subsequent Dark Age (ca. 1200–900 B.C.) very little, if any, glass was produced in the ancient world overall. New centers of manufacture emerged in Phoenicia and Assyria in the latter part of the eighth century B.C. Their products are markedly different from Late Bronze Age glass. One major advance was the casting of glass vessels in molds. The closed forms, such as these two alabastra, were cast as solid blanks, then cut down, drilled, and polished to achieve their final shapes. Vessels made by this method, while still luxury items, were a cheaper alternative to those made from semiprecious hard stones. The almost colorless alabastron from Cyprus, on the left, was meant to resemble rock crystal. The more unusual Mesopotamian example, on the right, was colored dark purple-red probably by the addition of manganese, perhaps in imitation of obsidian (a naturally occurring volcanic glass).

Although surviving examples of early cast-glass vessels are relatively few in number, they have been found across the ancient world, from Mesopotamia in the east to Spain in the west. They are thought to have been produced by Phoenician craftsmen, and Phoenician merchants doubtless played a part in their wide distribution. CSL with EVF, Department of Ancient Near Eastern Art



ARYBALLOS AND TWO OINOCHOAI

Greek (eastern Mediterranean or southern Italy), Hellenistic period, late 4th–early 3rd century B.C. Core-formed glass. Left: H. $6\frac{5}{16}$ in. (15.4 cm). Edward C. Moore Collection, Bequest of Edward C. Moore, 1891 (91.1.1383). Center: H. $3\frac{1}{2}$ in. (8.9 cm). Edward C. Moore Collection, Bequest of Edward C. Moore, 1891 (91.1.1348). Right: H. 6 in. (15.1 cm). Gift of J. Pierpont Morgan, 1917 (17.194.601)

The Mediterranean core-formed-glass industry flourished from the mid-sixth to the end of the first century B.C., when glass-blowing rendered it obsolete. Its production was restricted to a relatively small number of closed forms, and the standard shapes and types of decoration altered very little over the centuries. The tall, slender oinochoe (jug) and the lentoid aryballos (bottle) are two of the rarer shapes. These three examples also constitute some of the largest extant core-formed vessels.

Core-formed vessels have been found at sites throughout the Mediterranean region. Nevertheless, few details are known about the industry that produced them. Even the location of the major manufacturing centers remains the subject of scholarly debate. Core-formed vessels served as containers for precious oils, perfumes, and ointments and were used in a variety of ways—for storage in the home, as votive offerings at sanctuaries, and for anointing the dead in funeral rites. CSL



"ONYX" BOWL

Greek, Hellenistic period, 2nd–early 1st century B.C. Mosaic glass.
H. 5 $\frac{3}{8}$ in. (13.8 cm). Edward C. Moore Collection, Bequest of Edward C. Moore, 1891 (91.1.1303)

During the Hellenistic period, the patronage of kings and other rulers greatly stimulated the production of vessels carved in semiprecious stone, such as onyx and agate. Glass-makers soon discovered ways to offer well-to-do customers attractive imitations of such luxury vessels. In this case, in a variation on the mosaic-glass technique, canes consisting primarily of translucent, golden brown glass, but mixed with irregular circles of opaque white, were cut into a few large sections and fused together. While in color and pattern the bowl resembles onyx, its shape may derive from a pottery prototype. Its profile certainly would not have lent itself easily to being sagged over or cast into a mold, and the precise manner in which the bowl was made remains uncertain.

Although fragments of mosaic-glass wares are quite widespread, very few intact examples are known. This bowl is one of the star pieces to have survived. CSL



GARLAND BOWL

Roman, Late Republic or Augustan period, late 1st century B.C.
Cast glass. Diam. 7 $\frac{1}{8}$ in. (18.1 cm). Edward C. Moore Collection, Bequest of Edward C. Moore, 1891 (91.1.1402)

Four separate slices of translucent glass—purple, yellow, blue, and colorless—of roughly equal size were pressed together in a casting mold to make this bowl. Each quadrant was then decorated with fused-on millefiori glass representing a garland hanging from an opaque white cord. Very few vessels made of large sections or bands of differently colored glass are known from antiquity, and this is the only example that combines that technique with fused-on decoration. A monochrome, hemispherical bowl decorated with three similar garlands was found in 1932 at Taranto in southern Italy, in a tomb that has been dated to the reign of the emperor Augustus (27 B.C.–A.D. 14).

The Museum's bowl, published here for the first time since it was cleaned in the Sherman Fairchild Center for Objects Conservation (see p. 68), represents a masterpiece of glassmaking from the period when cast glass was beginning to be supplanted by the newly invented technique of glassblowing. CSL



VASE, JUG, AND CUP SIGNED BY ENNION

Roman, Julio-Claudian period, first half of 1st century A.D. Mold-blown glass. Left: H. $5\frac{5}{8}$ in. (14.3 cm). Gift of Henry G. Marquand, 1881 (81.10.224). Center: Found in Cyprus. H. $7\frac{1}{4}$ in. (18.4 cm). Gift of J. Pierpont Morgan, 1917 (17.194.226). Right: H. $2\frac{7}{16}$ in. (6.2 cm). Gift of J. Pierpont Morgan, 1917 (17.194.225)

Mold-blowing developed in the early decades of the first century A.D. as an offshoot of free-blowing. Craftsmen combined the use of the newly invented metal blowpipe with existing glass-casting and pottery-molding processes to produce blown-glass vessels that had a uniform shape, size, and appearance. The molds, which consisted of a number of parts that could be held tightly together but disassembled quickly after blowing, were reusable. Surviving examples indicate that they were made from a variety of materials: clay, stone, wood, and metal.

The earliest makers of mold-blown glass probably came from the Syro-Palestinian region, although their wares quickly became popular throughout the Roman Empire. A few made themselves into celebrities by carving their names on the molds; the most famous and gifted of these craftsmen was Ennion. It has been argued that Ennion, along with other glassworkers, may have moved from the Near East in the early first century A.D. to establish new workshops in Italy. These three vessels show both the variety of forms and the fine decorative details that Ennion employed in his work. CSL



OPAQUE BLUE JUG

Roman, Augustan or Julio-Claudian period, late 1st century B.C.–early 1st century A.D. Cast or blown glass. H. 7 in. (17.7 cm). Gift of J. Pierpont Morgan, 1917 (17.194.170)

This elegant jug, which imitates a metal vessel in shape, shows how quickly the newly founded Roman glass industry mastered its medium. The jug is so expertly crafted that modern scholars have disagreed about its method of manufacture. Some maintain that its body was cast and carved (like the alabastra on p. 19), while others regard it as an exquisite piece of early free-blown production. The handle was cold-carved and the base was cut on a lathe—both highly unusual techniques for blown glass that are paralleled only in some examples of early Roman cameo glass. It is likely, therefore, that the jug was made in a workshop closely associated with those that produced luxury cameos and that it represents a transitional phase in glassmaking when both casting and blowing techniques were used.

Once blowing took hold, craftsmen were quick to appreciate that working the glass while it was hot gave them greater flexibility and control and allowed them to produce a much wider range of attractive closed forms. Instead of being carved out afterward, handles, bases, and decorative elements could be incorporated as the vessel itself was being made, thereby speeding up and simplifying the manufacturing process. **CSL**



INSCRIBED GOBLET

Roman, 4th–early 5th century A.D. Said to have been found near Epiphania (Hama, Syria). Blown glass. H. 5 $\frac{7}{8}$ in. (14.9 cm). Charles Stewart Smith Memorial Fund, 1913 (13.198.5)

The Greek inscription ΠΙΕ ΖΗΧΗC —“drink [so that] you may live [well]”—is a common exhortation, found on pottery as well as on glass vessels. It is not necessary to detect in the words any Christian connotation associated with the Eucharist. Rather, they probably echo the kind of toast that would have been given at a drinking or dinner party—a view that is strengthened by the presence of two engraved grape clusters on the body of the vessel.

There is evidence suggesting that this goblet was both made and decorated at a workshop in Syria. However, it has been attributed to a group of vessels with engraved decoration and Greek inscriptions that includes a flask found in southern England. These widely dispersed provenances demonstrate the universality of the Roman glass industry, with makers, designs, and finished goods spread throughout the empire. In addition, such vessels indicate that glassmakers (*vitarii*) worked closely with specific glass cutters (*diatretarii*), supplying them with blanks to decorate, while ornamenting others themselves by adding trails and other hot-worked details. **CSL**



BARREL-SHAPED BOTTLE

Roman, late 2nd–early 3rd century A.D. Blown glass. L. $8\frac{7}{8}$ in. (22.5 cm). Gift of J. Pierpont Morgan, 1917 (17.194.305)

This bottle belongs to a small group of similar vessels that were probably made in a workshop at Cologne, on the Rhine, where at least one example has been found. Their function remains uncertain, but their practicality as containers may be doubted; in all likelihood, they were primarily decorative. The present vessel is unusually large, with delicate trails of dark blue glass wound around the body at both ends.

Barrel-shaped vessels made of glass or pottery seem to have been especially popular in the northwestern provinces of

the Roman Empire. This may reflect the routine use of wooden storage barrels in that region, where supplies of wood were more plentiful than they were around the Mediterranean. The most common type in glass is not free-blown (as this one is) but mold-blown and frequently has a stamp on the base bearing the name *Frontinus*. The stamp may be taken as a general trademark rather than as the signature of a specific maker, since surviving examples of that type are dated to the second through fourth century A.D. CSL

ASIAN ART

Historically, glass has not played an important role in the material culture of China—or, indeed, in that of any other part of East Asia. Imported glass, first from the Roman world and later from the Middle East, was highly valued as a luxury, but domestic glass never became popular for everyday use. This was most likely due to the early development of high-fired glazed pottery in China (beginning in about the 11th century B.C.), which meant that practical ceramic articles could be produced relatively cheaply in most parts of the country. There is also the question of aesthetic preference: high-fired, glazed wares had already become a medium of conscious artistic expression by the ninth century B.C.

Glassmaking, on the other hand, began in China only in about the fifth century B.C. Its history divides roughly into three periods. The chief characteristic of much Chinese glass of the early period (5th century B.C.–7th century A.D.) is its substantial lead content. In the first few centuries of this period, only solid objects created in molds are known, usually in forms borrowed from jade carvings. From the second century B.C. onward, glass vessels are also known.

In the middle period (7th–14th century A.D.), potash-lime and soda-lime glass was produced, with or without lead. At the site of a Yuan dynasty (1279–1368) glassworks in Zibo (formerly Boshan), Shandong Province, potash-lime glass with lead has been found. The chemical composition of the blue bowl illustrated on page 26 matches closely that of fragments excavated at Zibo.

In the late period (14th century and after), potash-lime glass continued to be produced, along with potash-lead glass. During the eighteenth century, soda-lime glass became quite common, with a chemical composition similar to that of contemporaneous European glass. It is likely that this type of glass was introduced by Jesuits at the imperial workshop in Beijing. After the workshop's demise in the nineteenth century, commercial production in the tradition of the palace wares continued through the early twentieth century, but with a general decline in quality. JCYW



OPAQUE BLUE BOWL

China, Yuan dynasty, 13th–14th century. Glass. Diam. of rim $6\frac{5}{16}$ in. (16 cm). Purchase, Edward S. Harkness Gift, 1926 (26.7.1273)

The bowl at left was acquired by Howard Carter and/or Lord Carnarvon in Cairo in the early twentieth century and purchased by the Metropolitan Museum in 1926. For many years, its date and provenance were the subject of much speculation. Tests conducted at the Metropolitan and at Corning Glass Works in 1988 finally established that it was made in China, probably during the Yuan period (1279–1368). Chemical analyses identified the bulk composition as lead-potash, with a significant amount of calcium fluoride; the latter was used by Chinese glassmakers as an opacifying agent much earlier than in the West.

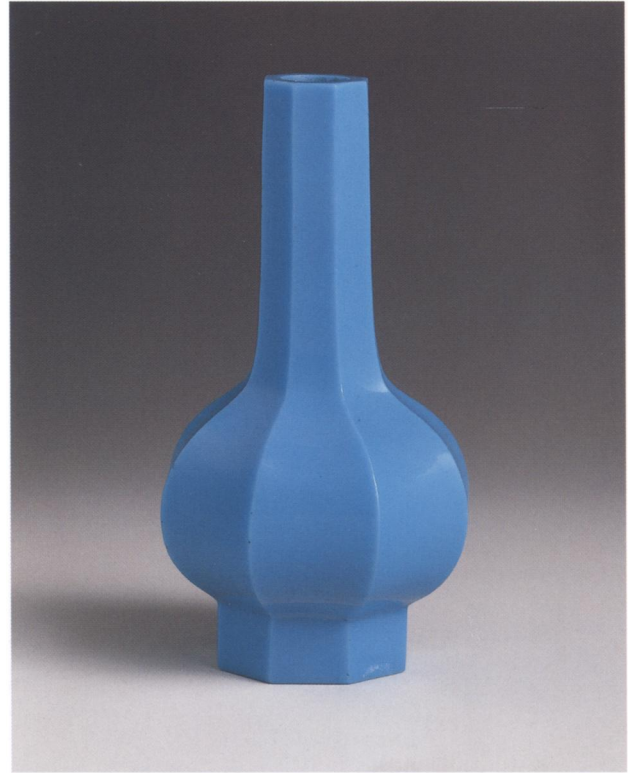
At the time of the bowl's original acquisition, archaeologists were beginning to report on finds at Fustāt, south of Cairo. In addition to Islamic pottery and fragments from local kilns, Chinese ceramics of the Song (960–1279) and Yuan periods were unearthed in considerable quantities. It is entirely possible that a Yuan glass bowl could have been brought to Fustāt, as either a trade item or an article used by traders, and eventually have turned up on the market in Cairo. Additionally, the shape and style of molding—with the walls becoming thinner toward the everted rim—are characteristic of ceramic bowls of the Yuan period. JCYW

BELT PLAQUES

China, Ming dynasty, 15th–16th century. Glass. L. of largest plaque 3 in. (7.6 cm). Charlotte C. and John C. Weber Collection, Gift of Charlotte C. and John C. Weber, 1994 (1994.605.104a–m)

These thirteen glass belt plaques are part of a single set, which, when complete, would have consisted of more than twenty pieces. Their shapes were based on those of the jade plaques that were stitched on leather belts and worn by Ming dynasty (1368–1644) officials. The arrangement of the plaques followed an established pattern, with the largest pieces typically placed at the center and at either end of the belt. The use of such plaques had its origin as early as the beginning of the Tang dynasty, in the seventh century, when the emperor presented jade-decorated belts to the nobility and senior members of the government as part of their official costume.

During the Ming, jade belt plaques were revived after a decline in the previous dynasties: historical documents record that Ming emperors had thousands of sets of jade plaques made in the imperial workshops to grant to officials. Glass pieces such as these were not inexpensive substitutes for their jade counterparts, however. They were valued for their own aesthetic appeal as well as for their exotic material. JJS



OPAQUE BLUE VASE

China, Qing dynasty, Qianlong period, 1736–95. Glass. H. $5\frac{3}{4}$ in. (14.6 cm). Edward C. Moore Collection, Bequest of Edward C. Moore, 1891 (91.1.1169)

A new chapter in the history of Chinese glassmaking began in 1696, the thirty-fifth year of the reign of Kangxi, when a glass factory was established within the imperial city in Beijing under the direction of the Jesuit missionary Kilian Stumpf (1655–1720). The type of glass produced there, of which this vase is an example, was subsequently known in the West as Peking glass. Craftsmen were recruited from Boshan, the traditional center of glassmaking in China, and from Guangzhou (Canton). The workshop's peak period, in both quantity and quality of its wares, was between 1740 and 1760, in the early reign of the Qianlong emperor. Palace records show that Jesuits with expertise in certain Western glassmaking techniques were active in the workshop at this time. After 1760, glass production in the palace workshop declined rapidly, as did the quality of the wares. This was also true of other workshops producing decorative arts for the palace—a result of the emptying of the imperial coffers.

This high-quality vase, which bears an incised mark reading “made in the Qianlong reign,” most likely dates to the early years of the reign. Its form closely resembles a type of vase known from the period immediately preceding the Qianlong. JCYW

ISLAMIC ART

The glass industry of the early and medieval Islamic lands (ca. 8th–14th century), from Egypt in the west to central Asia in the east, provided a wide variety of objects for everyday use as well as elaborate and expensive items for the affluent and the royal entourage. All of the known techniques for shaping and decorating blown glass were exploited, and ingenious new ones were invented. Patterns were created directly in molds; by tooling and manipulation while the glass was still hot; in the wheel-cut lapidary technique, after the glass had cooled; and by applying and firing enamels, metallic stains (lusters), gold leaf, and powdered gold. Applied trails and roundels, marvered trails—which were pushed into the walls of a vessel by rotating it against a smooth slab called a marver—and impressions made with tonglike implements were among the most common hot-worked decorative effects. The range of shapes, dimensions, and colors was also extensive. All manner of liquids and powders, oils, wine, rosewater, perfumes, spices, pharmaceuticals, cosmetics, and pigments filled bottles, flasks, jars, and vases made of countless shades of yellow, green, blue, purple, and brown, as well as colorless, glass.

Although progress has been made recently in the study of Islamic glass, it is nonetheless difficult to suggest precise attributions and to understand the art-historical development of glass in specific parts of the Islamic world. The difficulty has little to do with the fragile nature of the material, since a very large number of glass objects have survived intact to this day. One reason is the paucity of the Arabic and Persian inscriptions that are so informative in other media, such as metalwork. Another relates to the wide circulation of Islamic glass both within its area of production and beyond—eastward to China and Southeast Asia, westward to Europe and North Africa—as a prized item of exchange and gift. In addition, in what became a common practice throughout the world, Islamic glass was often recycled as cullet and remelted as low-cost fuel for the glassmaking process. It may even have been used as ballast, as has been deduced from the three tons of cullet and raw glass excavated in the late 1970s from an eleventh-century shipwreck off the coast of Turkey.

At present, the Metropolitan Museum houses about three hundred fine Islamic glass objects; especially strong is its collection of thirteenth- and fourteenth-century enameled and gilded pieces, which rarely appear on the market today. sc



CUP

Iran, 9th century. Blown and relief-cut glass. H. $2\frac{3}{4}$ in. (7 cm). Purchase, Joseph Pulitzer Bequest, 1965 (65.172.1)

Although it follows the taste for blown and wheel-cut glass in late Sasanian Iran and Mesopotamia (see the bowl on p. 10), that this small, well-proportioned object is nonetheless a product of Islamic culture is evident in the harmonious overall decorative treatment of the surface. Two staggered rows of omphalos motifs (from the Greek word for navel)—simply circles, each with a protruding prunt in the center—were created by cutting away the surrounding glass, leaving the circles in relief. The area below the main decorative zone is filled with a graceful design of flower petals radiating from the center of the base. Clearly, the cup was meant to be appreciated especially when not in use—that is, when it was placed upside down. At other times, when fulfilling its practical function as a vessel, its enjoyment would have been both tactile and visual: the relief of the design allowed for pleasant handling, whereas the translucency of the glass filtered the appearance of the drink (most likely red wine) in a manner satisfying to the eye.

Relief-cut glass from medieval Iran—here exemplified by a relatively simple geometric pattern, but often presenting complex vegetal and zoomorphic motifs—is one of the highest artistic achievements of Islamic glassworkers. **SC**



TWO GOBLETS

Possibly Syria, 10th–11th century. Blown glass with applied decoration. H. (left) $4\frac{5}{16}$ in. (11.5 cm); h. (right) $4\frac{7}{16}$ in. (11.3 cm). Friends of Islamic Art Gift, 2000 (2000.279.2, .1)

Perhaps the most common types of vessels created by medieval Islamic glassmakers were beakers and goblets. Sometimes, glasses bearing the same decoration were made in four or five different sizes in order to nest inside one another. More often, sets of glasses were produced with the same dimensions and decoration for use during drinking parties. These two goblets are the only two surviving glass vessels of this type clearly originating from the same set. The craftsman's individual manipulation and tooling account for the slight differences in their dimensions. The shape, color, quality of the glass, and ornamentation, however, are identical and prove that they were made in the same factory and probably from the same batch of glass.

The curling motifs around the walls, which are more evident when the glasses are filled, may have been inspired by Arabic calligraphy. The conical cup, short stem, and small foot provide an elegant profile for a drinking vessel—as often illustrated in the right hand of a princely character in manuscripts and on pottery or wood—that is easy to handle while imbibing but obviously cannot stand safely by itself. These goblets were stored upside down, like the cup on the left, or hung by the foot when not in use. **SC**



PITCHER AND TWO BOTTLES

Left: Probably Iran, 11th–12th century. Mold-blown glass. H. 5¾ in. (14.6 cm). Rogers Fund, 1947 (47.85.2). Center: Probably Iran, 10th–11th century. Blown and impressed glass. H. 7¼ in. (18.5 cm). Purchase, Rogers Fund, Louis E. and Theresa S. Seley Purchase Fund for Islamic Art, and Mrs. Charles D. Kelekian Gift, 1994 (1994.211). Right: Probably Iran, 9th–10th century. Mold-blown glass. H. 4½ in. (11.4 cm). Purchase, Louis E. and Theresa S. Seley Purchase Fund for Islamic Art and Rogers Fund, 1996 (1996.409)

These three objects illustrate effectively the range of shapes and decorative patterns for Islamic glass vessels throughout the medieval period, with special reference to the eastern Islamic world. Vegetal scrolls, geometric motifs, and rosettes (as seen above, left to right) appear ubiquitously on bottles, pitchers, and bowls with molded or impressed decoration, which were often embellished with a trail of darker color around the rim.

The two most common methods for patterning glass walls were with a mold or with a tonglike implement. In the former case, the glass was blown either into a one-piece, beaker-shaped dip mold bearing the design on its interior walls (and pulled

out while still attached to the pipe, after a quick inhalation that separated the glass from the bronze surface) or into a two-part mold, also of bronze, which was then opened to release the vessel. Alternatively, a tong with the desired pattern at its ends was clamped several times around the circumference of an object with an open form, such as a bowl or a plate. In rare instances, closed forms also bear impressed decoration: the bottle (above center) is an excellent example, in which the upper and lower parts were tooled separately as open forms, then joined at their edges by a difficult technique later called *incalmo* by Venetian masters. 5C



MOSQUE LAMP AND PLATE

Left: Egypt, ca. 1350–55. Blown glass, enameled, gilded, and stained. H. 13 in. (33 cm). Edward C. Moore Collection, Bequest of Edward C. Moore, 1891 (91.1.1537). Right: Egypt, ca. 1350–75. Blown glass, enameled and gilded. Diam. 8½ in. (21.6 cm). Edward C. Moore Collection, Bequest of Edward C. Moore, 1891 (91.1.1533)

Large enameled and gilded lamps were a true tour de force of glassworkers in Egypt and Syria during the Mamluk period (1250–1517), especially in the fourteenth century. Hanging by the dozens from the high ceilings of mosques, madrasas (Qur'anic schools), and mausoleums, these lamps, with their dim, flickering light, provided an intimate ambience conducive to prayer. Commissioned by sultans and emirs, they often present calligraphic inscriptions in lapis blue enamel and gold, including verses from the Qur'an and the sponsor's name. In the case of this lamp, the powerful patron was Great Emir Shaykhū al-Umārī (d. 1357), whose emblem of

office, a cupbearer's footed cup, is illustrated several times on the walls of the object. More than twenty lamps in the emir's name survive in collections around the world.

Enameled and gilded vessels were also made for secular purposes—from decanters and beakers for drinking parties to large basins for ablutions, lidded sweetmeat bowls, and spittoons. The low, flat plate shown above is unusual and probably functioned as a food tray. Busy decoration of the type we see here, consisting of complex geometric patterns filled with vegetal scrolls, rosettes, and stylized fleurs-de-lis, occurs often in Mamluk art, particularly from the mid-fourteenth century on. SC



DISH

India, early 18th century. Mold-blown glass, enameled and gilded. Diam. 4 in. (10.2 cm). Purchase, Mrs. Stuart Cary Welch Gift, 1987 (1987.158)

Glassmaking entered the artistic mainstream in Mughal India at the beginning of the eighteenth century, with objects—especially bases for water pipes—lavishly decorated in enamels and gold. Mughal vessels were usually made either of transparent and colorless glass or of vivid dark blue or green glass, which, glowing deeply behind the surface decoration, gave the objects a jewel-like appearance. A limited production, however, consists of pale green or, rarely, whitish glass that is both semitranslucent and opalescent. This opalescent type, exemplified by the present dish, was probably inspired by

carved objects in green or white jade, which were among the most expensive and sought-after items created for members of the Mughal court.

A small number of surviving circular and oval plates in molded green glass carry gilded and enameled decoration. This dish, though one of the smallest in diameter, is perhaps the most artistically accomplished; the large, striking pink blossom at the center, with its diminutive petals, is sometimes also found in contemporaneous illustrated manuscripts and on single pages from northern and central India. SC

MEDIEVAL ART AND THE CLOISTERS

The Metropolitan Museum's collection of medieval glass comprises a wide variety of vessels dating from the third through the early sixteenth century, but, unquestionably, its greatest strength lies in the near-encyclopedic holdings of stained glass: almost three hundred panels documenting all of the major northern European schools, with especially rich concentrations of the French and Germanic. Along with the masterpieces housed in the main building—including a border element (ca. 1144; acc. no. 1980.10) from Abbot Suger's ambulatory glazing at the abbey church of Saint-Denis, which is held to be the crucible of the French Gothic style—The Cloisters offers the opportunity of seeing still more major stained-glass windows installed in contemporary architectural surrounds.

The technique and aesthetic of stained-glass production evolved continuously throughout the Middle Ages, and this progress is well charted by the collection. Thanks to its undulant, glossy surface and saturated palette, High Gothic pot-metal glass—that is, glass to which colorants were added in the molten state—achieved a radiant, gemlike appearance. Striving for ever greater height and admittance of light, fourteenth-century windows employed thinner, more translucent glasses or colorless glass enhanced with grisaille decoration, eliminating colored glass altogether or confining it to borders, central bosses, or figural bands that stretched horizontally across the middle zones of the windows.

In the later Middle Ages, as the building of vast cathedrals gave way to more modest ecclesiastical structures, stained glass became more painterly. Individual pieces of glass typically conformed to the shapes of the elements they defined, and lead came played a lesser role in delineating form. Likewise, the compositions, whether devotional images or expanded narratives, were executed in larger scale, often across several lancets. Technical innovations were exploited to achieve a dazzling repertoire of visual effects. Two frequently encountered examples in later-fifteenth-century glass were the application of silver stain to colored (as opposed to white or colorless) glass, which produced a new palette of shimmering tonalities; and the selective removal, either mechanically or with acid, of one layer of flashed glass—made by fusing a thin sheet of colored glass to a colorless one—thus allowing shifts in color without lead lines.

During this period, production methods evolved as well. The exceptional Strasbourg Workshop-Cooperative of the late 1470s and early 1480s (see the *Mother of Sorrows* on p. 39) designed and executed windows of superb quality in a fixed style for numerous commissions from Strasbourg to Salzburg. Conceived in the twilight of the Middle Ages, this innovative and cost-effective cooperative arrangement seems remarkably modern even today. TBH



THEODOSIUS ARRIVES AT EPHEBUS (SCENE FROM THE LEGEND OF THE SEVEN SLEEPERS)

France (Rouen), ca. 1200–1205. Pot-metal glass and vitreous paint. 25 × 28⅞ in. (63.5 × 71.4 cm). The Cloisters Collection, 1980 (1980.263.4)

During the reign of Theodosius II (r. 408–50), a shepherd found seven men fast asleep in a cave. When one of them tried to buy bread with an ancient coin, he was brought before a prefect and a bishop. He testified that he and his companions had been converted to Christianity two centuries earlier and that God had saved them from persecution by putting them to sleep and sealing their hiding place with a boulder. Hearing the news of their miraculous resurrection, the emperor traveled from Constantinople to Ephesus to venerate them.

The extended cycle from which this panel comes is the earliest representation of this popular legend in monumental French stained glass. It was installed in the nave of Rouen's

Cathedral of Notre-Dame just after the turn of the thirteenth century. In the 1270s, when side chapels featuring lancet windows in the Rayonnant style were added, the earlier glass was altered to fit the taller and narrower apertures. Thus, none of the Seven Sleeper panels—originally composed of cluster medallions against a mosaic ground, like the contemporary windows at Chartres—survives in its early-thirteenth-century state. The expressive characterizations of the boldly silhouetted figures and the dramatic sense of narrative imparted by their articulation make these windows among the finest of the period, rivaling those of Chartres and Bourges. TBH

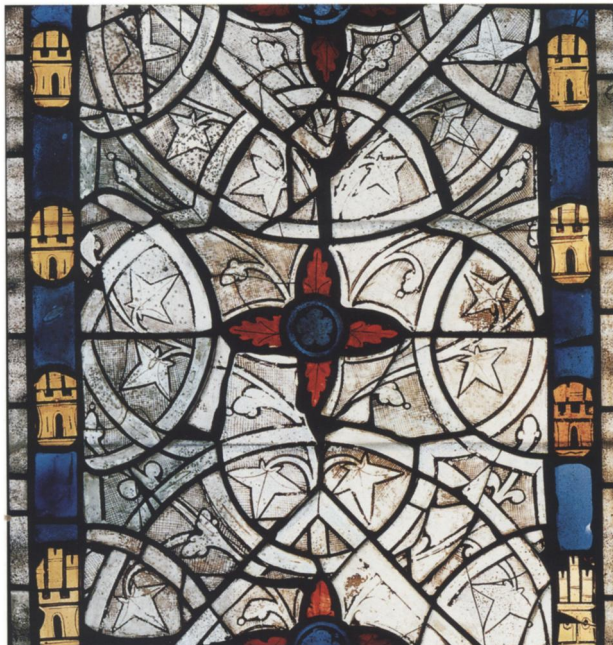


GRISAILLE PANEL *top*

France (Auxerre), ca. 1240–45. Colorless glass and vitreous paint. 23 × 22½ in. (58.4 × 56.2 cm). The Cloisters Collection, 1982 (1982.204.2)

GRISAILLE PANEL *bottom*

France (Rouen), ca. 1265. Colorless glass, pot-metal glass, and vitreous paint. 23½ × 22½ in. (59.8 × 57.5 cm). The Cloisters Collection, 1969 (69.236.2)



Grisaille glass enjoyed considerable popularity throughout the thirteenth and fourteenth centuries. The colorless panels embellished only with trace lines of dark vitreous paint at once allowed greater transmittal of light than colored (pot-metal) glass and riveted the eye with their fanciful and often complex geometric and foliate patterns. The top panel exhibits an integral, centripetal design typical of the mid-thirteenth century; the lead comes that hold together the differently shaped pieces of glass also emphasize the overall interlocking composition. The panel was probably removed from an axial chapel dedicated to the Virgin in Auxerre's Cathedral of Saint-Étienne during the restorations of the late nineteenth century.

The slightly later panel at bottom is a section of a window with an interlace-and-foliage pattern that continued from panel to panel. Pot-metal glass was introduced in the borders and central bosses, with the latter sometimes bifurcated by the panels' horizontal edges. The armorial devices in the vertical borders are those of Blanche of Castile, the daughter-in-law of Philippe Augustus (r. 1179–1223), who built the Château of Bouvreuil in 1205; Rouen's city walls were extended to incorporate the château by Blanche's son Louis IX (r. 1226–70), later Saint Louis. The royal workshop that created the elegant glazings for the Bouvreuil chapel, including this panel, probably came from Paris. TBH

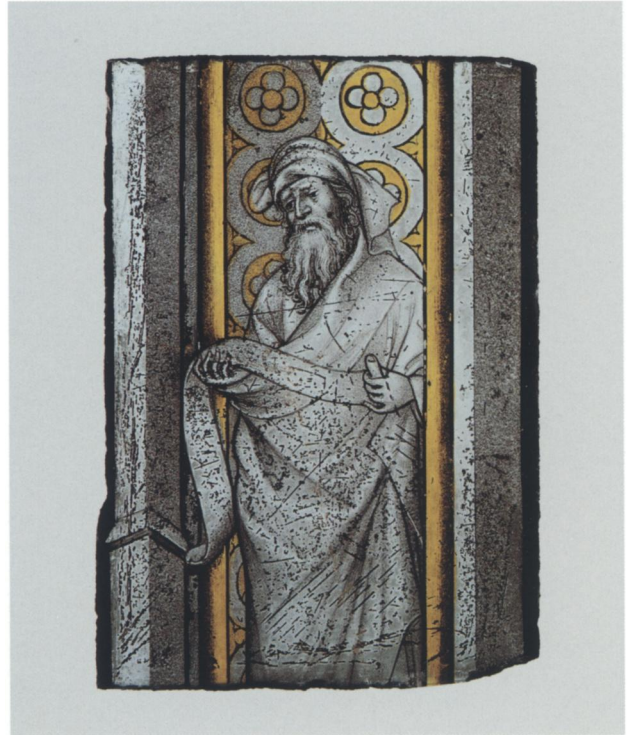


**NATIVITY AND CRUCIFIXION WITH SAINTS
(MEDALLION ATTACHED TO THE RELIQUARY
MONSTRANCE OF SAINT MARY MAGDALEN)**

Italy (Tuscany or Umbria), ca. 1375–1400. Colorless glass, gold leaf, oil glazes, and resinous fixative. Diam. 3¼ in. (8.3 cm). Gift of J. Pierpont Morgan, 1917 (17.190.504)

This gold-glass medallion is mounted atop a gilded-copper-and-rock-crystal reliquary monstrance said to contain a tooth of Saint Mary Magdalen. While the composition of the Nativity fills out and conforms to the circular format, the Crucifixion group on the reverse (not shown) is confined to a smaller circle surrounded by radiating bands, between which clear glass affords a view of additional relics. The imagery and composition of the Nativity, which were derived from the late-thirteenth-century frescoes in the upper nave of the church of San Francesco in Assisi, suggest that this reliquary had close links with the Franciscan order.

To make the medallion, gold leaf was applied to a glass disk, worked with a fine metal stylus, and held in place with a resinous fixative. The lines of the drapery folds in the Nativity are exceptionally supple, and the delicate modulation of tonalities, from light to dark, that describes the sculptural volumes of the figures brings an imposing monumentality to the miniature scene. The principal figures appear to hover miraculously in the dark void of space; only the diminutive witnesses, a young goatherd and his four charges, have their feet securely planted on the terra firma of the encircling frame. **TBH**



PROPHET (FRAGMENT OF A WINDOW)

France (Bourges or Burgundy) or South Lowlands, ca. 1390–1410. Colorless glass, silver stain, and vitreous paint. H. 6 in. (15.2 cm). The Cloisters Collection, 1995 (1995.301)

The significance of this glass painting of a prophet is belied by its small scale. Uncommonly refined and gemlike in its painterly finesse, the figure is related stylistically to the work of André Beauneveu (b. ca. 1335, d. 1403–13), a gifted sculptor, painter, and illuminator from the South Lowlands who enjoyed the patronage of the French court. However, Beauneveu's itinerant career and his collaboration with other artists working for the same patrons make it difficult to localize the origins of this work.

A striking comparison can be made with a monumental standing prophet in limestone that was probably executed by Beauneveu himself shortly after 1392 for the Sainte-Chapelle in the palace at Bourges. Beauneveu also designed stained glass for the chapel, which was glazed by 1408, although no direct connection can be established with the present piece. The prophet certainly belonged to a larger composition, possibly a Throne of Solomon, as described in 3 Kings 10:18–20 in the Douay Bible. In the later Middle Ages, the iconography of the Throne of Solomon was quite elaborate: the Virgin and child, seated on the throne of ivory and gold, were typically surrounded by personifications of the Virtues and by the prophets who foretold Christ's incarnation. **TBH**

MADONNA OF THE APOCALYPSE

Germany (Cologne), ca. 1430–35. Colorless glass, pot-metal glass, vitreous paint, and silver stain. 62¼ × 24 in. (158 × 61 cm). Bequest of George C. Pratt, 1935 (41.170.93a, b)

Images of the Virgin holding the Christ child, standing on a crescent moon, and surrounded by rays of light or “clothed in the sun” (*Strahlenkranz Madonna*) are inspired by an apocalyptic vision recounted in the Book of Revelation. Circumstantial evidence strongly indicates that this panel came from either the apse or the nave of the monastery church of Corpus Christi in Cologne, which had been rebuilt and enlarged by the Augustinian canons in the 1420s. The church was undoubtedly glazed by the time of its consecration (ca. 1430–35), but the remains of the glazings are insufficient to reconstruct the entire iconographic program. The soft, tubular drapery folds and the piling up of fabric at the Virgin’s feet hark back to the so-called Beautiful style (*Schöner Stil*) in wide currency throughout much of Europe a generation earlier; more particular to Cologne are the sparing use of pot-metal glass and the employment of colorless glass for the flesh tones.

In 1959, a Trinity and other fragments linked stylistically to the Museum’s panel were installed in the south window of the north transept of Cologne Cathedral; a copy of the Madonna was made in 1974 and subsequently installed in the north transept, as a pendant to the Trinity. TBH



BAPTISM OF CHRIST, AGONY IN THE GARDEN, CHRIST BEFORE PILATE, AND RESURRECTION (SCENES FROM THE LIFE OF CHRIST) *overleaf*

Austria (Ebreichsdorf), ca. 1390. Pot-metal glass, colorless glass, silver stain, and vitreous paint. W. (each) 12½ in. (30.8 cm). The Cloisters Collection, 1986 (clockwise from top left: 1986.258.4, .5, .7, .6)

The castle of Ebreichsdorf, south of Vienna, was originally a border defense for the city against invading Mongols, but in more peaceful times, toward the end of the fourteenth century, Rudolf von Tirna (d. 1406) decided to add a private chapel to the castle, which he had refurbished as a country residence. The chapel glazings, representing scenes from the life of Christ, were commissioned from a royal workshop in Vienna. The Infancy cycle filled the north windows; scenes from Christ’s public life, the south windows; and his Passion, the axial windows.

Having already withstood the Mongol attacks of the thirteenth century only to be plundered by the Turks in 1683, Ebreichsdorf would never return to its medieval splendor.

Except for one panel in Vienna, the windows now at The Cloisters (two entire double lancets; acc. nos. 36.39.16, 1986.258.1–.15, 1987.40.1–.2) are all that survive of the Ebreichsdorf glass. The windows in the original chapel were only a foot wide but almost twelve feet tall, which necessitated an old-fashioned compositional formula with a high horizon line: the figures in the background of each scene stand, in exaggerated recession, well above those in the foreground. The elegant figures, richly damascened backgrounds, elaborate canopies surmounting the scenes (not shown), close observation of detail, and vibrant palette endowed these windows with exceptional resonance and brilliance. TBH





MOTHER OF SORROWS (MATER DOLOROSA)

Strasbourg Workshop-Cooperative, Lautenbach Master. Strasbourg, ca. 1480. Pot-metal glass, colorless glass, and vitreous paint. 19 $\frac{1}{8}$ × 16 $\frac{3}{8}$ in. (49.8 × 41.6 cm). The Cloisters Collection, 1998 (1998.215b)

In about 1480, Peter Hemmel (active by 1447, d. ca. 1501) and his Strasbourg Workshop-Cooperative—a loose association, founded three years earlier, of glass-painting workshops that all employed Hemmel's style—were commissioned by the dean and chapter of Constance Cathedral to glaze the library. This panel, one of only two with figures to have survived, can be attributed on a stylistic basis to one of Hemmel's closest associates: the exceptionally gifted Lautenbach Master, so called after the parish church that houses his most extensive glazing program. His style is typified by the Virgin's delicately modeled, fleshy features and by the dramatic exuberance of the drapery, its broad planes juxtaposed with tubular folds and deep crevices. The definition of volumes and forms with mattes—subtly worked with the bristles of a dry brush (stumped) or with a stylus—rather than with trace lines and hatching is a hallmark of the cooperative, as are the lush, leafy branches set against a rich damascened background. This *Astwerk* is essentially a translation of canopies and tracery from an architectural to a vegetal vocabulary.

Although presented as the *Mater dolorosa*, the Virgin sheds no tears, and the calm serenity of her expression suggests that grief over the death of her son has been mitigated by a recognition of the redemptive value of his sacrifice. TBH



SORGHELOOS IN POVERTY

North Lowlands, 1510–20. Colorless glass, vitreous paint, and silver stain. Diam. 9 in. (23 cm). The Cloisters Collection, 1999 (1999.243)

Sorgheloos (“carefree” in medieval Dutch) was the antihero of one of the most popular moralizing stories of the late Middle Ages. Loosely based on the prodigal son of the Christian parable, Sorgheloos ignores all admonishments and embarks on the life of a spendthrift wastrel. Inevitably, the money runs out, friends abandon him, and Sorgheloos is ruined. Unlike the prodigal, who returns to a forgiving father, Sorgheloos, unredeemed, is condemned to poverty. Here, Sorgheloos sits forlornly on an upended washtub before a boiling kettle of herring in a barren, crumbling house. His only companion, besides a pitiable dog and cat, is Poverty, who can be seen through the doorway gleaning straw to feed the fire.

This harsh cautionary tale found considerable resonance among the God-fearing denizens of mercantile towns in the Lowlands. Silver-stained roundels were commissioned primarily for domestic, civic, or guild contexts and tended to reflect, in their varied subject matter, the concerns and values of such prosperous, hardworking people. This roundel's execution in several tones of dark paint and three hues of silver stain is unusually accomplished. The mattes were extensively worked with a badger brush to produce subtle gradations; details and outlines were indicated with both a stylus and the tip of a brush. TBH

ROBERT LEHMAN COLLECTION

The splendid collection formed over six decades by the financier Robert Lehman and his parents, Philip and Carrie, originally comprised well over three thousand works of art, most of which were bequeathed to the Metropolitan Museum at the time of Robert Lehman's death in 1969. To maintain something of the unique character of a private collection, many of these works are today exhibited in intimate galleries that evoke an elegantly appointed private dwelling. Among the treasures are late medieval, Renaissance, and modern paintings; Old Master drawings; manuscript illuminations; and a wealth of decorative arts, including 136 pieces of glass. Later European blown-glass vessels of the type illustrated on the following pages predominate, but there are also twenty pieces of ancient Roman and early Islamic glass, a small but fine selection of reverse-painted glass objects—picture frames, devotional pendants, and plaques—and an array of whimsical eighteenth-century lampworked figurines known as *verre de Nevers* after their original place of manufacture in central France. (Lampworking involves shaping rods and tubes of glass at an open flame with pincers and other tools.)

With two exceptions, the eighty-three Venetian and *façon de Venise* (French for Venetian-style) blown-glass vessels belonged to the collector Otto Hopfinger before Robert Lehman acquired them en bloc from the distinguished New York art dealer Leopold Blumka. Lehman frequently amassed works in this fashion, acquiring in a single transaction, either at auction or through private sale, a large portion of a renowned collection, be it of majolica, Old Master drawings, picture frames, or—as in this instance—glass.

As a private collector rather than a museum curator, Robert Lehman did not endeavor to form encyclopedic holdings in any area; instead, guided by his own taste and preferences, he bought what he judged to be the finest examples of whatever genre, medium, or period pleased him. The European glassware testifies to his predilection for finely wrought precious objects, and the Venetian and *façon de Venise* blown-glass vessels reflect his lifelong affinity for Italian art. Though not an avid collector of Venetian painting, Lehman was captivated by the works of eighteenth-century Venetian draftsmen, particularly Giambattista and Domenico Tiepolo, which he accumulated in quantity. The rich concentrations of drawings and glass from Venice can be understood as corollary aspects of his collection. LW-5

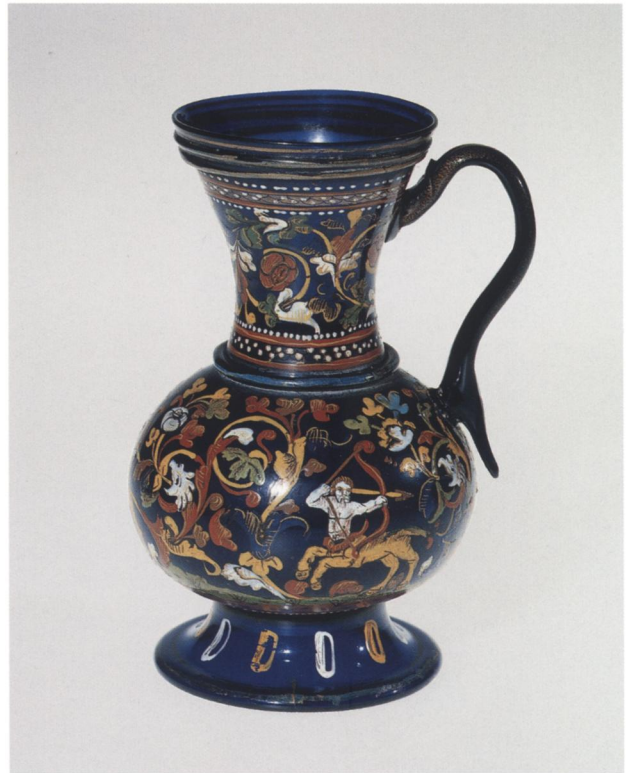


ARMORIAL TAZZA

Probably Venetian (possibly French), 1499–1514. Diam. of rim 10 $\frac{3}{8}$ in. (27.6 cm). Blown glass, pattern-molded, enameled, and gilded. Robert Lehman Collection, 1975 (1975.1.1194)

This tazza bears on its foot the coats of arms of Louis XII of France (1462–1515; r. 1498–1515) and Anne, duchess of Brittany (1477–1514). It may have belonged to a service made on the occasion of their marriage in 1499. There are no contemporary written documents referring to such a service, but three other surviving pieces embellished with the same armorial devices—as well as a now-lost painting or tapestry executed at the time of the wedding that reputedly depicted two matching tazzas—suggest that one did indeed exist.

It is uncertain whether the Lehman tazza was made in Venice or France, as enameled glass was being produced in both places by the end of the fifteenth century. Venetian glassmakers often employed forty-ribbed molds of the type that was used to fashion the bowl of this tazza, but craftsmen emigrating from Venice to France would also have had the wherewithal to make such a mold. The use of insufficient lime in the glassmaking process has caused a type of deterioration known as crizzling (see p. 68)—a phenomenon that occurs in both Venetian and *façon de Venise* glass. The tazza's place of manufacture thus remains, at present, unresolved. LW-5



JUG

Venetian, ca. 1500–1510. Blown glass, enameled and gilded. H. 8 $\frac{1}{4}$ in. (21 cm). Robert Lehman Collection, 1975 (1975.1.1172)

This elaborately decorated jug is one of the finest pieces of glass in the Robert Lehman Collection. Both the neck and the body are richly ornamented with scrolling acanthus vines, stylized flowers, and grotesque masks and animal heads. A grassy ground delineated just above the foot provides a stage for three rearing centaurs bearing bows and arrows. Deployed at evenly spaced intervals around the body of the jug, the mythical beasts are encircled by leafy tendrils set against the azure background. The jug's decorative vocabulary recalls that of contemporary Italian majolica (tin-glazed earthenware), on which vines, masks, and other classicizing motifs are combined with figures or narrative scenes. The engaging *drôleries*—vignettes enacted by tiny beasts and hapless humans, often framed by curling, leafy vines—that fill the borders of late medieval illuminated manuscripts may well have provided the anonymous glass painter with an additional creative stimulus.

Nothing is known of the Venetian workshop from which this splendid jug originated, although a number of pieces executed in a similar technique have been identified. Together, these works provide an intriguing, if still sketchy, profile of an accomplished but otherwise unrecorded glassmaking enterprise. LW-5



THREE FOOTED BOWLS

Left: Venetian, ca. 1500. Blown chalcedony glass. Diam. of rim 11 $\frac{1}{8}$ in. (28.4 cm). Robert Lehman Collection, 1975 (1975.1.1196). Center: Venetian, ca. 1500. Blown glass, pattern-molded, enameled, and gilded. Diam. of rim 11 in. (27.9 cm). Robert Lehman Collection, 1975 (1975.1.1197). Right: Venetian, ca. 1500–1525. Blown glass, enameled and gilded. Diam. of rim 10 $\frac{1}{2}$ in. (26.7 cm). Robert Lehman Collection, 1975 (1975.1.1185)

Footed bowls of both colorless and colored glass were commonly produced in Venice from the mid-fifteenth century onward. They were typically decorated in enamel, either with small figural scenes or with diaper or scale patterns—the latter exemplified on the dark blue bowl shown above. In addition, many Venetian glass vessels of the period, such as the purplish gray bowl in the center, have raised ribs radiating around the body, a decorative flourish achieved through the employment of a mold.

On the far left is a striking example of chalcedony glass (*calcedonio*), which was intended to emulate agate, jasper, and other hard, polished stones. The marbled effect was

accomplished by dissolving a variety of metallic compounds, including silver (otherwise rarely used in the fabrication of glass), in nitric acid and adding that solution to molten glass without mixing thoroughly. Probably invented by the fifteenth-century Venetian glassmaker Angelo Barovier, the technique is described in Antonio Neri's famous treatise *L'arte vetraria* (*The Glassmaker's Art*). Published in Florence in 1612, this text divulged many secrets that had been jealously guarded by generations of Venetian craftsmen. When its recipes were faithfully followed, according to the author of a 1699 French translation, "it will seem as if nature herself could not arrive to the like perfection, or art imitate it." LW-5

GOBLET *opposite*

Probably South Netherlandish or German, 17th century. Blown glass, trailed, pincered, and *vetro a retorti*. H. 11 $\frac{1}{16}$ in. (28.1 cm). Robert Lehman Collection, 1975 (1975.1.1206)

Known as a dragon-stem goblet because of its fantastical shape evocative of a twisting serpent with combs, jaws, and fins, this type of wineglass was first made on the island of Murano, center of the Venetian glassmaking industry, in the late sixteenth century. The form became immensely popular, and in the seventeenth century *vetri ai serpenti* were produced in

great number, not only in Murano but also in factories throughout the southern Netherlands and Germany specializing in the manufacture of glass *à la façon de Venise*. Venetian-made goblets of this type did not, as a rule, have the flat stem seen in this handsome example, which is therefore presumed to be of Netherlandish or German origin. LW-5





ARMORIAL TAZZA AND JUG

Venetian, ca. 1513–34. Diam. of rim (left) 9 $\frac{1}{8}$ in. (23.1 cm); h. (right) 7 $\frac{3}{4}$ in. (19.8 cm). Blown glass, enameled and gilded. Robert Lehman Collection, 1975 (1975.1.1190, .1170)

Two members of the powerful Medici family of Florence ascended to the papacy in the first half of the sixteenth century: Leo X in 1513 and his cousin Clement VII in 1523. Both continued the tradition of lavish patronage established by earlier generations of the Medici, commissioning numerous works of art both monumental and precious in scale. The Medici coat of arms—five red *palle* (balls) and a sixth in blue with three gold fleurs-de-lis—invariably appears on works produced for Leo and Clement, surmounted by the crossed keys of Saint Peter and a papal tiara.

This jug and tazza were once part of a large service of glass tableware. Most of the known pieces are bowls and footed tazzas, although two other jugs are preserved. The great variation in the quality and detail of the enamel decoration suggests that the pieces were made over a period of time rather than in a single undertaking; they are therefore likely to have originally comprised more than one service. Owing to the absence of specific personal devices, it is impossible to determine if they were made for Leo or for Clement. In fact, both pontiffs probably commissioned this type of tableware for their household use. LW-5

EUROPEAN SCULPTURE AND DECORATIVE ARTS

The Metropolitan Museum's Department of European Sculpture and Decorative Arts maintains a comprehensive collection of approximately 2,100 objects that demonstrate the evolution of finer glassmaking across Europe from the mid-fifteenth to the end of the nineteenth century. The Museum's first acquisition in this field, in 1881, consisted of a group of vessels given by James Jackson Jarves, who had scientifically assembled them to exemplify all of the techniques for working the highly refined glass of Venice. German and Austrian enameled and engraved glass arrived in 1927 through the purchase of half of the celebrated Mühsam Collection, the rest of which is in the Art Institute of Chicago. Examples of Spanish, Dutch, and German green glass spanning the sixteenth to the late nineteenth century, made by methods that had survived essentially intact from the Roman era, were also given at an early point in the Museum's history by Henry Marquand and others. English and Dutch engraved and cut glass is well represented for the eighteenth and nineteenth centuries, and the small but important group of French glasses includes pieces from glasshouses in Normandy, Orléans, and the Margeride region of the Cantal. There is also a small number of Scandinavian and Russian glasses.

Throughout the period covered by the department, from 1450 to 1900, glassmaking was characterized generally by a constant striving both to improve the material itself (with aesthetic as well as economic goals in mind) and to render it capable of expressing changing styles and tastes. Each major type of glass—from the soda glass of Venice to the harder German potash metal to the soft lead glass of England and Ireland, with its unique internal fire—has its own strengths and decorative possibilities; but in this selection of works illustrating the department's holdings, those that could be associated with a particular glassmaking center, glasshouse, or individual maker or decorator were given preference.

In addition to vessels, there are engraved gold-glass plaques as well as some 150 stained-glass windows and smaller panels from the early sixteenth to the late nineteenth century, the largest collection of post-medieval stained glass in this country. Especially important are two large windows and four oculi by Valentin Bousch from the sixteenth-century glazing program of the choir of the abbey of Flavigny, which are displayed in the Museum's Bastie d'Urfé Chapel, on the first floor of the main building. JMcN



GOBLET

Venetian, ca. 1485. Blown glass, trailed, enameled, and gilded.
H. 8½ in. (21.6 cm). Gift of J. Pierpont Morgan, 1917 (17.190.730a, b)

Glasses colorfully decorated with pictorial narratives paralleled the taste for painted cassone (large coffer) fronts in the later fifteenth century. Here, in four scenes, a rather vicious medieval tale is related. Virgil, the great poet of ancient Rome—misremembered in the popular imagination as a sorcerer—dangles in a basket for all to see beneath the tower window of the emperor's daughter, Febilla, who had falsely promised to admit him during the night. When Virgil, by his magic art, extinguishes all the fires of Rome, the emperor releases the poet-sorcerer and must agree to his revenge: the fires are to be rekindled from a live coal set upon Febilla's naked, exposed body. Holding his book of magic, Virgil observes her humiliation from the city walls.

The anonymous miniaturist who designed these vignettes may also have executed them, working in close collaboration with a Murano glass furnace. Many fifteenth-century artists moved with ease from large frescoes to panel paintings to miniature manuscript illuminations. The goblet is one of a small group of surviving glasses enameled with tiny pictures that all appear to have been the work of the same hand. They may have been made at the glasshouse established in Venice by Angelo Barovier (d. 1460) and continued by his family. Compositional analysis conducted at the Museum indicates that the goblet's foot and most of its stem are a later (probably 19th-century) replacement. **JMcN**



ROEMER

Dutch (probably Amsterdam), early 17th century. Blown and applied glass with diamond-point engraving. H. 11¼ in. (28.6 cm). Gift of Mrs. Samuel P. Avery, 1904 (04.24)

Whereas for centuries red wine was drunk from clear glass flutes, the white wines of the Rhineland were served in a *Roemer*, a wineglass with a hollow, cylindrical stem decorated with applied glass prunts in the manner of many ancient Roman beakers. This example, the body and stem of which were formed from a single gather of glass, was made unusually large in order to accommodate the map engraved across its barrel-shaped bowl. The engraving was based on a famous map of the Rhine by the mathematician and cartographer Caspar Vopel, which was published in Cologne in 1555. On the *Roemer*, the river's course from Mainz to Utrecht is shown, with its many tributaries and branches and the adjacent lands, cities, and physical features.

Engraving on glass with a diamond point is reported to have first been practiced in Venice in 1530 by one Vincenzo de Anzola. Initially, the technique was employed primarily for armorials, abstract ornament, and sprays of flowers and leaves, but in the Netherlands at the beginning of the seventeenth century, more ambitious work was done, and in a wider range of designs. Diamond-point engraving leaves a burred, misty trace of great charm. It is especially effective on colored glass, as here. **JMcN**



BEAKER AND WINEGLASS

Left: Johann Schaper (German, 1621–1670), enameleur. Nuremberg, 1664. Blown and enameled glass. H. 3 $\frac{3}{8}$ in. (9.8 cm). Gift of R. Thornton Wilson, 1950 (50.211.285). Right: Johann Heinrich Meyer (German, 1680–1752), enameleur. Saxony (Dresden), ca. 1720–30. Blown glass, enameled and gilded. H. 5 in. (12.7 cm). Munsey Fund, 1927 (27.185.232)

These two examples of glass enameled in Germany are separated by about sixty years. When the beaker, on the left, was made, the district around Nuremberg had already been a glassmaking center for over a century; from about 1625, many engravers and enameleurs settled in the city itself. A native of Hamburg, Johann Schaper at first made stained-glass windows, from which, undoubtedly, he learned to achieve the bright, atmospheric effects akin to watercolors that we also see in his translucent enamels. Schaper enameled other glasses and porcelain with images more exactly inspired by engravings in Jacques Callot's *Thirty Years' War* (1618–48) series; this poignant scene of bedraggled foot travelers taking refreshment at a springhouse evokes the return of soldiers after the war.

The wineglass, on the right, displays a unique type of enameling invented by Johann Heinrich Meyer, who remained its sole practitioner. First, he painted a landscape background in opaque enamels directly on the wineglass. Then, by building up glass threads over an armature of fine copper wires, he sculpted minute three-dimensional figures, which were then fused onto the surface. Here, we see an elegantly clothed shepherd and shepherdess walking toward an apple tree; one of their sheep notices a wolf concealed in a bush. The miniature scale, delicacy of color, and humor of this work reflect the taste of the Saxon court at Dresden in the early eighteenth century. **JMcN**



COVERED BEAKER

Circle of the Master of the Koula Beaker. Austrian (Bohemia), 1690. Blown and engraved glass. H. (with cover) 8 $\frac{7}{8}$ in. (22.5 cm). Munsey Fund, 1927 (27.185.42a, b)

This beaker is of hard, thick-walled lead-potash glass. The anonymous engraver, fulfilling a special commission, worked with exquisite skill. Depicted on one side (not shown here) is an exuberant arrangement of mixed flowers in the manner of Dutch flower paintings of the mid-seventeenth century and the engravings they inspired. On the opposite side—facing us in this photograph—are the arms and crest of the aristocratic Kinkebiel von Grunenwald family of Saxony, ensigned by a marquis's coronet and helm. Flanking the shield to the left and right are the figures of Hope and Faith, an allusion to the sentiment engraved on the beaker's lid: "Durch Hoffnung und Gedult / Erlang Ich Gotes Shuld" ("Through Hope and Patience I reach God's grace").

The beaker's dazzling embellishment was achieved by grinding the design—but not very deeply—into the glass with a wheel; selectively wheel-polishing the hollows; and adding with a diamond point fine details such as the veins of a leaf or the texture of a feather. Only a handful of surviving glasses of such impressive and elaborate workmanship are known. JMcN

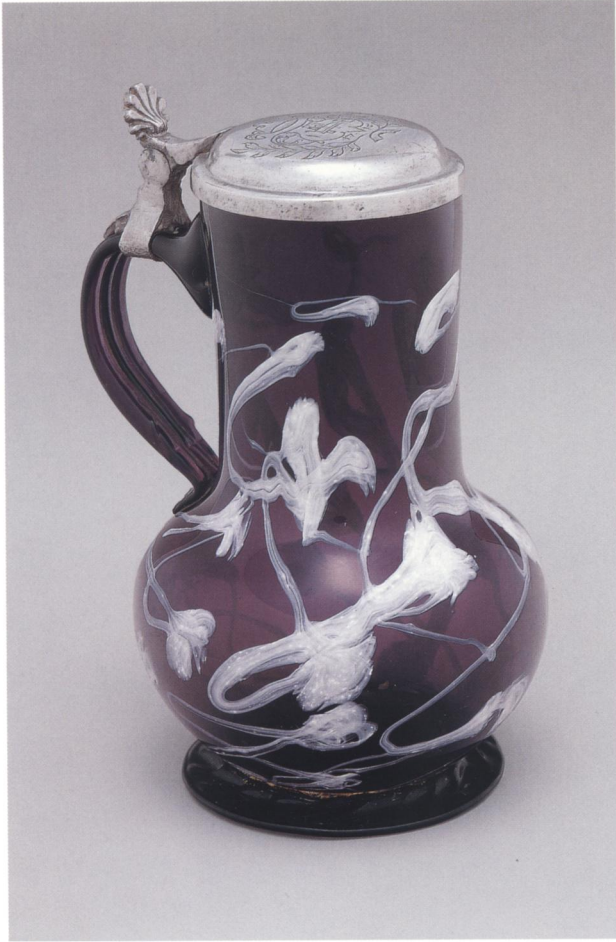


COVERED GOBLET

Matthäus Baur II (German, 1653–1728), silversmith. South German (Bavaria, Freising), ca. 1695–1700. Mold-blown gold-ruby glass, gilded silver, and lacquer. H. 3 $\frac{3}{8}$ in. (8.6 cm). Munsey Fund, 1927 (27.185.309a, b)

Although a copper-based translucent red glass had been made in the Middle Ages for stained-glass windows, and opaque red glass had an even longer history, not until 1679 did the chemist and alchemist Johann Kunckel (ca. 1630–1703), working at the glass factory established at Drewitz (near Potsdam) by the elector Friedrich Wilhelm of Brandenburg, develop the first gold-based red glass for the production of vessels. The secret—which he derived, in part, from old recipes and the practical experiments of Andreas Cassius in Leiden, among others—was to introduce a precipitate of gold and tin into the molten glass batch, then reheat the batch to bring about the proper dispersion of particles for the desired ruby color.

Kunckel's method soon became known. At Freising, sixteen miles north of Munich, a most attractive gold-ruby glass was made. This pear-shaped goblet, complete with green leaves and a winding brown stem, is a good example of the imaginative Freising wares, many of which were sent (as was this piece) to Augsburg for the addition of silver mounts. Christian V of Denmark gave a very similar goblet to Queen Charlotte-Amélie at Christmas 1695. Gold-ruby glass was understandably costly and, it was thought, had the additional value of protecting its owner from poison or other harm. JMcN



TANKARD *top left*

French (Nevers), 1716. Blown and applied glass. H. 7¾ in. (19.7 cm).
Bequest of Edward C. Moore, 1891 (91.1.1204)

SPA GLASS *bottom left*

French (Orléans, Verrerie Royale), 1726. Blown and enameled milk glass.
H. 2⅞ in. (7.3 cm). Gift of Dr. Eugen Grabscheid, 1982 (1982.97.6)

These two very different-looking vessels have one thing in common: the use of an opaque white glass known in France as *blanc de lait* and appreciated for its resemblance to porcelain. The radiant, translucent purple body of the tankard was decorated by unusual means: thick milk glass was taken straight from the furnace and almost scribbled on, rather than applied as an enamel. The white's intensity strongly suggests that the place of manufacture was Nevers, where the quality of the white glass was especially brilliant.

The beaker is of a milky white glass, soft in tone, that was produced by followers of Bernard Perrot (active 1649–1709) at the glasshouse he had established with royal support at Orléans in 1662. Its sophisticated, octagonal form was derived from Far Eastern sources, such as bell-shaped Chinese porcelain cups and faceted Japanese lacquer containers. The beaker's inscription, "Je fais du bien a tous" ("I do good to everybody"), perhaps refers to the waters of a particular spa, and the blue bird may have been an emblem of the town where it was located. The bird occurs on several other spa beakers of similar shape, which are recorded with dates ranging from 1709 to 1738. JMcN



27.185.281 (see p. 50)



BEAKER *previous page*

Aleksandr Petrovich Vershinin (Russian, active 1759–1822), decorator. Penza province (Nikol'sk, Bakhmet'ev factory), ca. 1800. Blown and cut glass with silver leaf, gold leaf, moss, painted paper, enamel, straw, and mica. H. 4 $\frac{1}{8}$ in. (10.5 cm). Munsey Fund, 1927 (27.185.281)

The creator of this enchanting double-walled beaker adapted, in an entirely Russian way, a technique that had originated in Dresden in the early eighteenth century. Two glasses, ground to fit one inside the other, were firmly sealed together at the lip once the three-dimensional tableau was in place on the outer wall of the interior glass. Nearly all of the materials used for the tableau were quite valueless in themselves but appropriate in texture or color for rendering a country manor, trees, clothing, a river, clouds, people, and animals. Depicted are three linked incidents that were probably of great significance to the person who commissioned the beaker. Standing at their front door, a couple receive a letter from a messenger. In the second scene, the husband turns to watch as a groom approaches a barn or stable, while in the third scene, a dog chases a rabbit up a hill, birds soar overhead, and a waterfall gushes in the distance.

Aleksandr Petrovich Vershinin, a serf-craftsman who signed and dated a similar beaker in 1802, was described by the owner of the Bakhmet'ev glasshouse as “one of our best workers” and “the first master in my glass factory.” JMcN

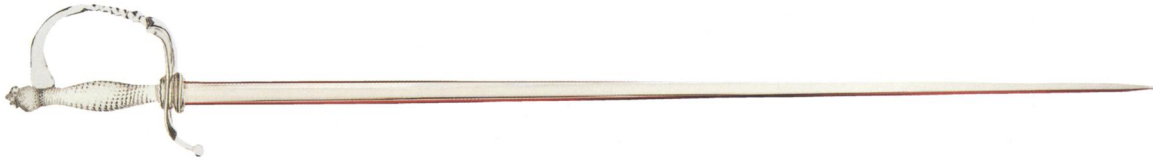
RELIEF PLAQUE OF PASIPHAË *above*

Césaire-Isidore-Henri Cros (French, 1840–1907). Sèvres, ca. 1895. W. 13 in. (33 cm). Glass (*pâte de verre*). Purchase, Edward C. Moore Jr. Gift, 1924 (24.131.1)

Henri Cros was a classically educated painter, sculptor, and ceramist, but not originally a verrier. From 1870 he made bas-reliefs in colored waxes; then he sought a less fragile material that could also be colored in the process of sculpting rather than painted afterward. This search brought him, around 1882, to experiment with a method first used in ancient Egypt. He arranged different colors of powdered glass in a mold, then fired it in a kiln at a temperature just high enough to fuse the glass particles but not so high that they would melt and the colors run together. This is *pâte de verre*.

The excavations of Sir Arthur Evans on Crete in 1894–1900 may have inspired Cros to revive the Minoan myth of Queen Pasiphaë, who loved a white bull and is shown here lifting her arm to adorn the docile animal with a garland of flowers. Like many of the artist's other female mythological figures, she has a proper Greek profile. The deliberate irregularity of the plaque's outline suggests a piece of fresco torn from the wall of an ancient palace. In 1895 Cros received the Légion d'Honneur and was given a studio on the property of the Sèvres porcelain factory, near Paris. JMcN

ARMS AND ARMOR



SMALL-SWORD

French (Choisy-le-Roi), 18th–19th century. Glass. L. 39¼ in. (99.7 cm). Gift of Jean Jacques Reubell, in memory of his mother, Julia C. Coster, and of his wife, Adeline E. Post, both of New York City, 1926 (26.145.345)

The holdings of glass in the Department of Arms and Armor were for the most part acquired for iconographic or archaeological reasons. They form part of a study collection developed by the department's founding curator, Bashford Dean (1867–1928), who classified such ancillary material under the general heading of “documents.” For Dean, this term encompassed any artifact or work of art that might serve to deepen the modern student's understanding of the history and development of arms and armor.

Among these “documents” are eighteen panels of European stained glass dating from the thirteenth to the sixteenth century, all of which include depictions of armored warriors or militant saints. The most noteworthy is *Saint Michael and a Donor* (acc. no. 28.84), an ensemble from a large window made in France, possibly Paris, around 1500. The other significant grouping of glass in the collection comes from the ruins of Montfort castle, a Crusader stronghold in Palestine that was destroyed in 1271. Along with a number of architectural elements and objects of daily life, the Montfort excavation of 1926—organized, partially funded, and led by Dean—uncovered approximately four hundred fragments of glass vessels, which appear to be of both European and local manufacture.

Certainly the most weaponlike example of glass in the collection is a small-sword made in France during the late eighteenth or early nineteenth century. In the seventeenth and eighteenth centuries, there was a vogue for glass drinking vessels in the form of pistols and powder flasks. Glass swords and daggers are known to have been worn on ceremonial occasions by members of European and British glassmakers' guilds. They were also made from leftover glass as novelties and demonstration pieces. The latter may be the case with this sword, which is said to have been made by a glassblower in Choisy-le-Roi, a small village outside Paris known principally as the site of a château that once belonged to Louis XV. DJL

MUSICAL INSTRUMENTS



TRANSVERSE FLUTE IN D

Claude Laurent (French, active by 1805, d. 1848).
Paris, 1813. Glass and brass. L. 24¾ in. (62.9 cm).
The Crosby Brown Collection of Musical Instruments,
1889 (89.4.924)

The Department of Musical Instruments houses fourteen objects that are composed essentially of glass or that use glass to generate sound: one harmonica, three sets of water-tuned glasses, three glassichords, one crystallophone, two flutes, one table bell, and three small horns. Except for one or two pieces made in the United States, the items were all manufactured in Europe between about 1810 and 1880. Almost all of them came to the Museum in 1889 with the Crosby Brown Collection, which was assembled with the aim of representing the full range of sound-producing apparatus from the Western and non-Western worlds. Thus, the group encompasses virtually every kind of glass instrument used during the nineteenth century.

Highlights include an unsigned Bohemian glass harmonica of about 1830 (acc. no. 89.4.1211)—a late example of the type invented by Benjamin Franklin in about 1762. One set of tuned glasses (acc. no. 1980.504) is a harmonicon for which Francis Hopkinson Smith of Baltimore received a patent in 1825. The best of the three glassichords is a small keyboard instrument in the shape of a table, manufactured by Chappell and Company of London in about 1815 (acc. no. 1971.188); its pianolike action strikes tuned glass rods.

Finally, there are two transverse flutes of colorless lead glass by the Parisian watchmaker and mechanic Claude Laurent, each furnished with four keys (acc. nos. 16.130, 89.4.924). Laurent developed the technology to make glass flutes in 1806 and remained their sole manufacturer during his lifetime. In the early nineteenth century, the great majority of flutes were made of wood. Though fragile and thus more popular with amateurs than with professionals, glass flutes were in fact less susceptible than wooden ones to the effects of humidity and temperature fluctuation within the air column. Laurent used various formulations of glass in different colors, including blue cobalt and green uranium glass, and the surfaces were usually grooved, as pictured here, or faceted. HH

AMERICAN DECORATIVE ARTS

Glassmaking was America's first industry, as witnessed by two attempts, in 1608 and 1621–24, to establish a factory at Jamestown, Virginia. The industry saw only modest success, however, until the second decade of the nineteenth century. That entrepreneurial Americans were then able to challenge the domination of European imports is a testament to the highly skilled glassmakers—mainly immigrant laborers trained abroad—whom they employed. Although the mainstay of early glassmaking was window glass and bottles, a variety of tablewares were also made of the same unrefined green glass. The tradition of fabricating such articles for everyday use continued throughout the nineteenth century at glasshouses located in fuel-rich rural areas of New York State and southern New Jersey.

The luxury glasshouses that emerged in the early nineteenth century, notably in Pittsburgh, Pennsylvania, and in Sandwich and East Cambridge, Massachusetts, made predominantly colorless lead glass in large quantities and in a wide variety of table forms. Following fashionable products from abroad, some featured applied and tooled decoration, while others were cut and engraved in the Anglo-Irish style. More affordable than these luxury wares were mold-blown pieces with geometric patterns that recalled cut-glass designs.

America's most significant contribution to glassmaking was the development, in about 1825, of an even more economical, mechanized method involving the pressing of molten glass into a mold with a metal plunger. Pressed glass achieved a distinctive decorative vocabulary, including, in the early decades, an allover stippling that yielded a sparkling appearance, from which the term "lacy glass" was coined. By the mid-nineteenth century, glassmakers were turning out pressed-glass vessels of many shapes and sizes, all in a single pattern. At the same time, new developments in glass engraving and cutting were yielding fresh effects, often based on colorful Bohemian styles. By 1880, a rich cut glass that refracted light from its many facets was being produced by deep and elaborate allover cutting on heavy blanks.

In the last decades of the nineteenth century, there was a tremendous explosion of exoticizing "art glass." Its most notable producer in America was Louis Comfort Tiffany. Beginning in the late 1870s, his work in windows led to him to experiment with new types of varicolored and -textured glass, and in 1893 he added blown glass to his burgeoning repertoire of decorative media, much of it inspired by nature. His Favrite vases—a great strength of the Metropolitan's collection—were the first American glasses to receive international acclaim. ACF



COVERED GOBLET (POKAL)

New Bremen Glass Manufactory (American, 1784–97) of John Frederick Amelung (German, 1741–1798). New Bremen, Frederick County, Maryland, 1788. Blown and wheel-engraved glass. H. 11¼ in. (28.6 cm). Rogers Fund, 1928 (28.52)

When this covered goblet was discovered and purchased by the Metropolitan Museum in the late 1920s, it brought to light for the first time the work of an important, hitherto-unknown eighteenth-century glasshouse. Despite the engraved inscription, which provides the name and location of the factory, the goblet's sophisticated form and skillful engraving caused some experts initially to doubt its American provenance. In fact, it dates to the earliest year of surviving engraved work from John Frederick Amelung's factory. Its profile and style of engraving attest to the Germanic heritage of the craftsmen who fashioned and decorated it. The inverted-baluster-shaped stem relates closely to those of contemporary pokals from Kassel, Germany. The vessel's dominant feature, however, is the elaborate, wheel-engraved rendition of the coat of arms of the city of Bremen within a Baroque shield, characteristic of the most complex engraving on Amelung glass.

That this particular goblet turned up in Bremen, Germany, illuminates its inscription of "Old Bremen Success and the New Progress": it may have been sent by Amelung to his financial backers in Germany as a testament to the success of his glass factory in the new country. ACF



DECANTER

Bakewell, Page and Bakewell (American, 1824–32). Pittsburgh, Pennsylvania, ca. 1826. Blown and cut lead glass with encased sulphide. H. 7¾ in. (18.7 cm). Purchase, The Overbrook Foundation Gift, 1995 (1995.13)

Embedding a high-fired ceramic image, or sulphide, in glass was one of the most fashionable and difficult techniques of European glass ornamentation. When the bubble of glass was still on the blowpipe, the end was opened and the sulphide inserted, at which point the glassblower had to inhale through the pipe in order to deflate the bubble around it. As part of the ongoing effort by American glass factories to compete with imported foreign wares, cut-glass tumblers with sulphide portraits embedded in the base were introduced in 1825 by the Pittsburgh firm of Bakewell, Page and Bakewell. A newspaper account of a Baltimore retailer's stock described the Bakewell tumblers as "a novel, curious and elegant specimen of American industry and talent." Distinguished personages whose portraits appeared in such tumblers include Benjamin Franklin, George Washington, Andrew Jackson, De Witt Clinton, and the marquis de Lafayette. Lafayette's 1825 visit to the United States may have been the impetus for their introduction.

Decanters rarely received this type of decorative treatment. Here, the crisply modeled sulphide bears the signature of a Philadelphia medalist, Christian Gobrecht. Gobrecht engraved this portrait of Franklin (after a Thomas Sully likeness) for a medal commissioned by the Franklin Institute in Philadelphia in 1825. ACF



SUGAR BOWL

Boston and Sandwich Glass Company (American, 1825–88), New England Glass Company (American, 1818–88), or South Boston Flint Glass Works (American, 1819–?70). Sandwich, East Cambridge, or South Boston, Massachusetts, 1820–35. Blown lead glass. H. (with lid) 9 $\frac{7}{8}$ in. (25.1 cm). Gift of Mr. and Mrs. Robert Keller, in memory of Gretchen Keller, 2000 (2000.509.2a, b)

The period of 1815 to 1820 saw several important factories—in Pittsburgh, in and around New York City, and in Massachusetts—commence the production of lustrous, colorless glassware in stylish forms that could compete with the boatloads of English glass that flooded the American market. This elegant sugar bowl is among the most sophisticated to emanate from one of three possible Massachusetts factories.

Rather than achieving a decorative effect through cutting and engraving, the glassworker manipulated the material in its molten state: the lower body of the bowl received a second gather, or coating, of glass, which was then tooled into horizontal ribs; next, the ribs were drawn upward to create a striking swaglike pattern that is repeated on the lid and finial. The bold overall profile—tall, waisted, and footed—is associated with both the South Boston and East Cambridge firms. Also distinctive to the New England glasshouses is the squat, rounded, hollow stem; the stems of some versions contain coins that help to date those examples. ACF



CELERY VASE

Boston and Sandwich Glass Company (American, 1825–88). Sandwich, Massachusetts, 1830–40. Pressed lead glass. H. 7 $\frac{5}{16}$ in. (18.6 cm). Purchase, Mr. and Mrs. Paul R. Greenwood Gift, 1986 (1986.237)

Celery vases were popular in the second quarter of the nineteenth century, gracing the table as elegant repositories for this vegetable, then considered a luxury. Domestic and imported celery vases of richly cut glass inspired American makers to produce vessels that gave the appearance of the costlier cut glass but were fashioned and decorated by the more economical means of pressing. In the early years of its production, beginning in about 1825, pressed glass tended to mimic popular patterns in cut glass, bringing its charms to a wider range of consumers thanks to reduced labor costs.

This example, which exhibits the characteristics of early pressed wares—namely, a flinty gray color and surface irregularities—was produced at the Boston and Sandwich Glass Company. Led by founder Deming Jarves (1790–1863), the firm secured two important early patents for mechanized pressed-glass processes. “Celleries” were among the contents of the four hundred casks of Boston and Sandwich glassware advertised for sale in 1849 in New Orleans. The deep, bucket-shaped bowl on a stem was also produced in both cut and mold-blown glass. The pressed version shown here displays a pattern of stylized tulips and leaves with a scalloped rim. ACF



PRESENTATION VASE

New England Glass Company (American, 1818–88). East Cambridge, Massachusetts, 1843. Blown lead glass, cut and wheel-engraved. H. 13 in. (33 cm). Purchase, Robert G. Goelet and Mr. and Mrs. William H. Hernstadt Gifts, 1980 (1980.69)

This cut and engraved presentation vase is one of the most impressive examples of American glass ever made. Its shape relates closely to metal forms emblematic of the classical revival of the 1820s through the 1840s, and the broad cut panels around the base of the bowl suggest the heavy gadrooning found on silver vases and tea wares of the period. The engraved view of the New England Glass Company complex depicts its two glass furnaces and one red-lead furnace, as seen from the east across the Charles River. Such representations of glass factories on glass are extremely rare. These were prosperous years for the company; by 1845 it had nearly 250 employees, and its seven decades of continuous operation are probably the longest of any nineteenth-century American glass factory.

In a curious reversal, Henry Whitney presented the vase to Thomas Leighton in August 1843 on the occasion of his own retirement (as “A token of grateful remembrance,” according to the engraved inscription). Whitney had served as the firm’s agent, or general manager, since 1825, while the talented Leighton had emigrated from Edinburgh to the United States in 1826 and become the firm’s gaffer, or master glassblower, and superintendent. ACF



PRESENTATION VASE

Long Island Flint Glass Works (American, 1852–63) of Christian Dorflinger (American, b. France [Alsace], 1828–1915). Brooklyn, New York, 1859. Blown lead glass, cut and wheel-engraved. H. 16 $\frac{7}{8}$ in. (42.9 cm). Gift of Isabel Lambert Dorflinger, 1988 (1988.381.1)

The New York metropolitan area produced America’s finest cut glass from about 1825 until 1861. The three factories established in Brooklyn toward the end of that period by Christian Dorflinger were among the most successful. His second factory, at which this vase was made, included a cutting shop with thirty-five stations, or cutting frames. The tall, slender form is a virtual compendium of cut patterns: fans culminating in a scalloped rim, lozenges with cross-hatching, a horizontal midrib, circles, a faceted stem, and a star-cut foot that echoes the lozenge-and-fan design of the upper portion. Together, this tour-de-force craftsmanship and the message of the engraved inscription—“Presented by the officers / & Members of the / Dorflinger Guards / To Mrs / Dorflinger. / January 14th / 1859”—demonstrate both the skill and the loyalty of Dorflinger’s immigrant workforce. The Dorflinger Guards, a “colorfully uniformed body of trained men,” served as a local constabulary at a time when American communities lacked organized municipal police forces.

Dorflinger’s products enjoyed such a reputation that in 1861, when Mrs. Abraham Lincoln needed a full service of fine cut glass for the White House, she purchased glassware made at one of his factories through a retailer in Washington, D.C. ACF



BOTTLE, POCKET BOTTLE, AND SUGAR BOWL

Left and far right: American (Midwestern states), 1820–50. Mold-blown glass. H. (left) 8 in. (20.3 cm); h. (far right; with lid) 7 in. (17.8 cm). Gift of Henry G. Schiff, 1980 (1980.502.69; .85a, b). Center: Attributed to glassworks of Henry William Stiegel (American, 1769–74). Manheim, Pennsylvania, 1769–74. Mold-blown glass. H. 4¾ in. (12.1 cm). Gift of Frederick W. Hunter, 1914 (14.74.17)

One of the few glass objects that can be confidently identified as eighteenth-century American, the amethyst pocket bottle shown above (center) exemplifies the fusing of Continental and English glassmaking traditions. Pocket bottles with molded floral designs were popular in southern Germany and Bohemia, and Henry William Stiegel, to whose rural Pennsylvania factory the Museum's bottle is attributed, employed skilled German glassblowers. English influence is seen in the use of refined amethyst glass; Stiegel may have been capitalizing on the boycott of imported English goods, including glass, that was a reaction to the Townshend duties imposed by the British Parliament in 1767.

The tradition of mold-blown bottles and tablewares survived well into the nineteenth century, though few documented examples survive. Their brilliant colors—usually amber, turquoise, or citrine—show off their molded patterning to advantage. The globular bottle and sugar bowl at left and right display a boldness of shape associated with the products of Midwestern factories, and an Ohio provenance has long been supposed. The sugar bowl features a so-called broken-swirl or basket-weave pattern, achieved by swirling a rib-molded glass bubble on the end of the blowpipe, then reinserting it into the mold so that the vertical ribs cut through the swirls. ACF



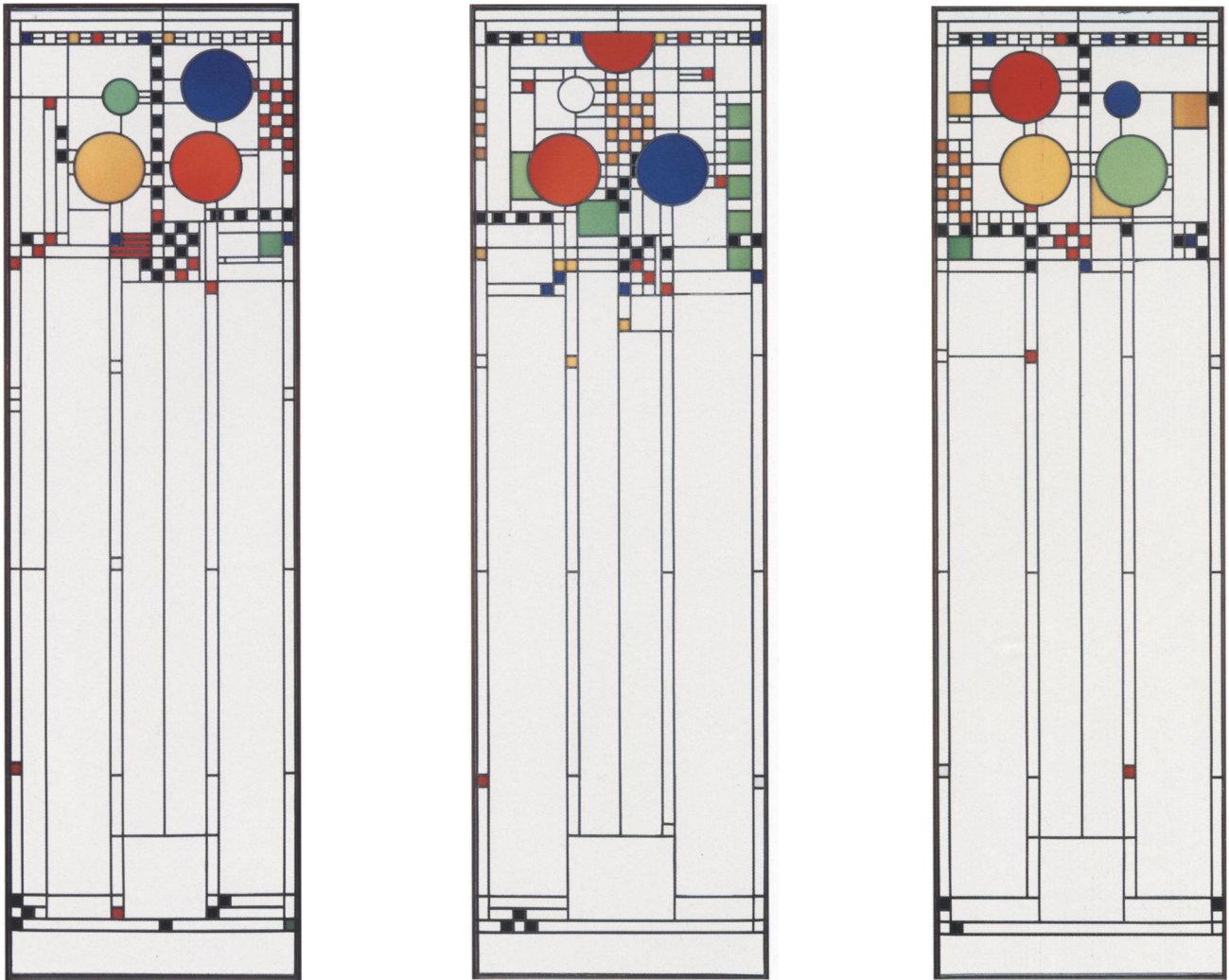
PEACOCK VASE, BOWL, AND VASE

Left: Tiffany Glass and Decorating Company (American, 1892–1902) of Louis Comfort Tiffany (American, 1848–1933). Corona, New York, 1893–96. Blown Favrite glass. H. 14 $\frac{1}{8}$ in. (35.9 cm). Gift of H. O. Havemeyer, 1896 (96.17.10). Center: Tiffany Furnaces (American, 1902–20) of Louis Comfort Tiffany. Corona, New York, 1908. Blown Favrite glass. H. 6 $\frac{5}{8}$ in. (16.8 cm). Gift of Louis Comfort Tiffany Foundation, 1951 (51.121.13). Right: Tiffany Glass and Decorating Company, 1893–98. Blown and cased Favrite glass, cut and engraved. H. 12 $\frac{1}{4}$ in. (31.1 cm). Purchase, William Cullen Bryant Fellows Gifts, 1997 (1997.409)

For the blown glass that his company began producing in 1893, Louis Comfort Tiffany drew inspiration from ancient Rome, the Islamic world, Venice, and Bohemia, as well as from such contemporary European glassmakers as Émile Gallé and Karl Köpping. Iridescent and lustrous, his trademarked Favrite glass was a technological marvel. Yet nature was Tiffany's constant muse. He captured the essence of the peacock's plumage in one iridescent vase, while a nearly colorless vase with a flush of blue-white opalescence at the rim features Queen Anne's lace—a favorite motif of Tiffany's in many media—and lily pads of bright spring green. The delicate cutting on this second vase is attributed to Fredolin

Kreischman[n] (1853–1898), who had excelled at Thomas Webb's firm in Stourbridge, England, before emigrating to the United States in 1892 or 1893.

Tiffany also made a type of Favrite glassware that combined thick, smooth areas of gold with rough black surfaces. The organic and irregular shape of the bowl shown above (center) conveys the waywardness of molten lava in flux. It is part of a large group that Tiffany personally lent to the Metropolitan in 1925 and that became a gift upon his death. Much earlier, in 1896, H. O. Havemeyer—who, along with his wife, Louisine, was one of the artist's early patrons—had given the Museum its first pieces of Tiffany glass, including the peacock vase. ACF



TRIPTYCH FROM THE AVERY COONLEY PLAYHOUSE

Frank Lloyd Wright (American, 1867–1959). Riverside, Illinois, 1912. Glass and zinc. H. (each) 86¼ in. (219.1 cm). Purchase, The Edgar J. Kaufmann Foundation and Edward C. Moore Jr. Gifts, 1967 (67.231.1–3)

This stained-glass triptych—considered Frank Lloyd Wright’s masterpiece in glass—is in direct contrast to the lush, highly naturalistic windows of opalescent glass in myriad hues and textures made by John La Farge and Louis Comfort Tiffany, which are amply represented in the Metropolitan’s collections. It is also distinct from the stained glass Wright designed on numerous other occasions, which favored earth tones and stylized patterns that were ultimately based on nature. Made for one of his most acclaimed commissions—a kindergarten or playhouse for Avery Coonley in Riverside, Illinois—the three panels reveal Wright’s love of geometry and his genius with proportions, adapted from his knowledge of architectural

spaces. Originally placed at the front of the playhouse, they read as a self-contained work, yet they also related to the larger program of clerestory windows that encircled the rest of the building.

The theme of this “Kindersymphony,” as Wright often referred to it, is inherent in the bold color scheme and the crisply abstract two-dimensional design, which together convey the impression of a parade with flags and balloons. The windows also reference the abstract compositions of contemporary European painters, which Wright would have seen on his travels abroad just prior to receiving the commission from the Coonley family. ACF

MODERN ART

The roots of the studio-glass movement were established as early as the 1870s, when the French designer Émile Gallé made a radical change in the prevailing attitude toward his medium by being the first modern glass artist to sign his individual creations, just as painters and sculptors did. Nevertheless, art glass—that is, one-of-a-kind works—continued to be blown in factories, such as Orrefors in Sweden, Tiffany in the United States, and Lalique in France, that were better known for their production wares. It was not until the 1960s that the contemporary studio-glass movement was born, when a critical mass of artists were making glass independently of factories, on their own premises and with their own equipment.

The intervening years had brought isolated experimentation by a few daring individuals. The French painter Maurice Marinot started blowing glass in a factory setting in the early 1910s. In Cleveland in the 1950s, Edris Eckhardt, a ceramist and self-taught glass sculptor, invented her own glass formulas, which she melted in a converted electric ceramic kiln. Apart from glass casting in Czechoslovakia, lampworking in Germany, and some *pâte de verre* (see the plaque on p. 50) in France and Japan, there was little hot glasswork being done in artists' studios.

In 1962, Harvey Littleton, a professor of ceramics at the University of Wisconsin, held a series of informal workshops on the grounds of the Toledo Museum of Art to explore the possibility of hot glassworking in a studio setting. Dominick Labino, the director of research at the Johns-Manville Fiber Glass Corporation and an acquaintance of Littleton's, attended the workshops, contributed his technical expertise, and went on to devise the first glass formula that would both melt at the low temperatures generated by small, portable furnaces and provide a consistency suitable for blowing. Littleton's and Labino's efforts unleashed a flurry of creativity not seen before in the field of glass.

Today, glass has become an integral part of the international art world. Glass artists' ongoing explorations of new forms, new combinations of materials, and new ideas promise an exciting future. JA



"AUTUMN CROCUS" VASE

Émile Gallé (French, 1846–1904). Ca. 1900. Blown and inlaid glass (*marqueterie de verre*). H. 17 $\frac{3}{8}$ in. (44.1 cm). Gift of Lloyd and Barbara Macklowe, 1984 (1984.553)

Having learned glassmaking as a child by watching his father make blown-glass objects for the family's retail shop in Nancy, Émile Gallé continued his studies in Germany, Paris, and London. By 1874, he had become artistic director of his father's prosperous business and begun to produce art glass in his own factory. During the 1880s and 1890s, he made vast amounts of production-line lamps, vases, and tableware while at the same time developing original techniques for creating and decorating unique glass vessels. A student of botany and an enthusiastic gardener, Gallé was particularly taken with Art Nouveau, the contemporary style informed by nature's curvilinear, asymmetrical features. More than three hundred of his works were shown at the Union Centrale des Arts Décoratifs in Paris in 1884.

Gallé's *marqueterie de verre* technique was inspired by inlaid decoration, or *marquetry*, in wood. Shaped pieces of hot glass were pressed into the body of an object, and the flat surface, once it cooled, was often engraved, carved, or embellished with additional applications of glass. The elongated purple crocuses of fall, which Gallé saw as a symbol of melancholic beauty, became the theme for a whole series of vases, including "Autumn Crocus." JA



WINEGLASS

Ludwig Heinrich Jungnickel (German, 1881–1965) and Josef Hoffmann (Austrian, 1870–1956), J. and L. Lobmeyr (Austrian, est. 1823) for the Wiener Werkstätte (Austrian, 1903–32). 1910–11. Blown glass enameled and acid-etched. H. 7 $\frac{1}{4}$ in. (18.4 cm). The Cynthia Hazen Polsky Fund, 1993 (1993.323)

In 1903 the Austrian architect and designer Josef Hoffmann, along with Koloman Moser (1868–1918), founded the Wiener Werkstätte: a workshop for the design and production of decorative arts, based on Charles Robert Ashbee's Guild of Handicraft in England. Hoffmann rejected the prevailing Art Nouveau style, with its sinuous curves and references to nature, and espoused a geometric, rectilinear, and largely undecorated modern style, for which the Werkstätte's metalwork, furniture, jewelry, and textile shops became known in their early years.

This goblet was a collaboration between Hoffmann, who designed the form, and Ludwig Heinrich Jungnickel, who designed the curvaceous and stylized frieze of monkeys crouching within spiraling, fruit-laden vines. Jungnickel used the so-called *bronzite* technique to execute his design: first he applied an overall layer of black enamel (bronzite), then a resist (probably wax) to protect the pattern from a hydrofluoric acid bath, which removed the unwanted bronzite and etched the glass to a matte finish. The elegantly undulating stem may have been Hoffmann's response to the bowl's curvilinear ornamentation. JA

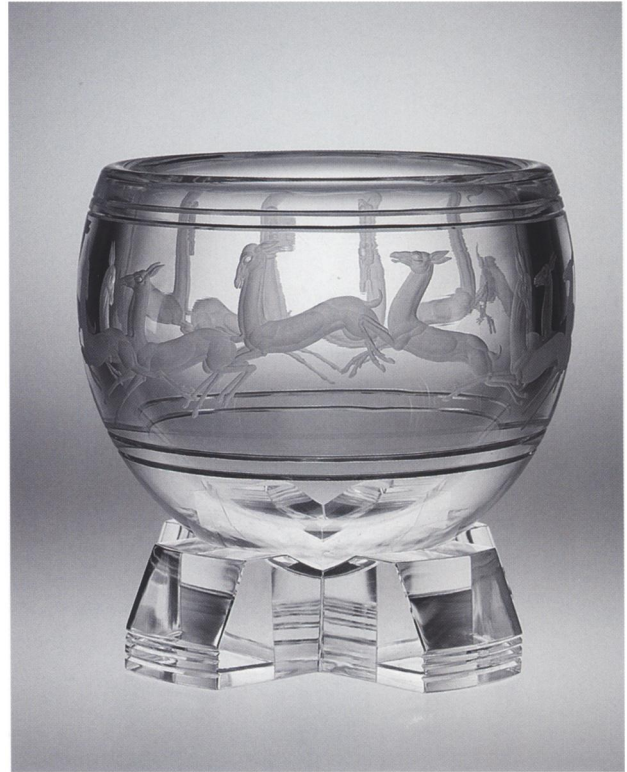


"HAUTE VIGNE" CUP

René Jules Lalique (French, 1860–1945). 1912. Mold-blown and enameled glass. H. 7 in. (17.8 cm). Purchase, Edward C. Moore Jr. Gift, 1923 (23.173.1)

As a young student, Lalique had shown great artistic promise and a profound love of nature. In 1876, while enrolled at the École des Arts Décoratifs, he began an apprenticeship with Louis Aucoc, a leading Parisian jeweler. Shortly after he took over a workshop on place Gaillon, in 1885, he began experimenting with glass in order to incorporate it into his avant-garde jewelry, along with semiprecious stones and organic materials such as horn and ivory. The motifs were inspired by nature. By 1912, however—having begun as early as 1905 to display larger glass objects in his new shop on place Vendôme—Lalique abandoned jewelry making to concentrate wholly on a career as a *verrier*, or master glassworker. Not only did his designs for perfume bottles, fountains, architectural panels, and tableware herald both Art Nouveau and the style later known as Art Deco, but from 1921, at his factory in Alsace, he revolutionized production technology as well.

The "Haute Vigne" cup was designed in 1912 and manufactured until 1928. The elegant goblet was enameled in a semiabstract manner. Pale, almost colorless vegetation winds thickly about the stem of the goblet and bears fruit or blossoms when it reaches the bowl. JA



"GAZELLE" BOWL

Sidney Biehler Waugh (American, 1904–1963); Corning Glass Works (American, est. 1868), Steuben Division. 1935. Blown glass, cut and engraved. H. (with base) 7¼ in. (18.4 cm). Purchase, Edward C. Moore Jr. Gift, 1935 (35.94.1a, b)

Sidney Biehler Waugh won the Prix de Rome in 1929 after studying sculpture under Émile-Antoine Bourdelle in Paris. In 1932 he returned to America and settled into a studio on Bleecker Street in Greenwich Village, where he concentrated on making architectural sculpture until the Corning Glass Works hired him in 1933 to begin reorganizing its Steuben Division. Waugh became the chief designer for Steuben and remained in that position until his death.

The massive "Gazelle" bowl, with its solid, cross-shaped base, was blown from colorless lead glass, then cut and engraved with gracefully loping gazelles. The gazelle was one of the classically inspired motifs often used in French Art Deco objects of the 1920s, which were clearly an inspiration to Waugh. The matte surface of this elegant design heightens the crystal's extreme clarity and exceptional degree of transparency—a Steuben signature. JA



"FIREWORKS" VASE

Edward Hald (Swedish, 1883–1980) for Orrefors Glasbruk (Swedish, est. 1898). 1921. Blown glass, flashed and engraved. H. 8¾ in. (22.2 cm). Purchase, Edward C. Moore Jr. Gift, 1927 (27.96.5)

Although Edward Hald studied under Henri Matisse and began his career as a narrative painter, in 1917 he was hired by the Swedish firm Orrefors Glasbruk, where he remained for over six decades. He adapted the bold color palette and stylized figures and forms he had favored in his original medium to the task of decorating objects made by the Orrefors craftsmen. His early attempts to engrave glass with a copper wheel produced a rough, shallow sketch that he did not like. Later, he revitalized the engraving technique by cutting sharper, often deeper contours, which allowed him to produce a more expressionistic picture.

Hald's designs tend to be witty narratives with an anecdotal edge. Both playful and elegant, they concentrate on line rather than relief effects. In the "Fireworks" vase, children and adults move among waving trees while rockets explode above their heads in a cascade of stars and fans. The bowl-like shape, expanding upward and outward, ingeniously represents the vault of the heavens; a thin layer of deep blue glass, fused to the clear form underneath (a method known as flashing) and selectively cut away to produce the design in cameo, contributes to the illusion. "Fireworks" was included in the Metropolitan Museum's 1927 exhibition "Swedish Contemporary Decorative Arts." JA



FLASK WITH STOPPER

Maurice Marinot (French, 1882–1960) 1923 Blown and acid-etched glass. H. 6¾ in. (17.1 cm) Purchase, Edward C. Moore Jr. Gift, 1924 (24.131.4a, b)

Maurice Marinot, who had begun his career as a Fauvist painter, became fascinated with the properties of glass as a potential medium while visiting friends who owned a glass factory in Bar-sur-Seine. At first, Marinot experimented by enameling clear blanks supplied by the factory. By 1912, however, no longer satisfied with simply decorating, he apprenticed himself to the factory's gaffers and soon was blowing his own forms and engraving or acid-etching geometric and abstract patterns onto their surfaces. As integral decoration, he introduced gold specks, used different colors of opaque glass in tandem, and even exploited the random, trapped air bubbles considered undesirable by other glassworkers. In 1924 the Metropolitan Museum purchased three of his vessels directly from his sole Parisian agent, the well-known gallery owner (and maker of Degas's bronzes) Adrien Hebrard. In 1925 Marinot's glass won universal acclaim at the Exposition des Arts Décoratifs et Industriels in Paris.

Marinot worked the surface of this chunky bottle by repeatedly immersing it in hydrofluoric acid, which cut deeply into the glass wall where it was unprotected by resist and left in relief a spiral pattern defined by trapped pink swirls. Rejecting functionalism, Marinot equated glassworking with the art of painting; accordingly, he signed each of his bottles, flasks, and stoppered jars. **JA**

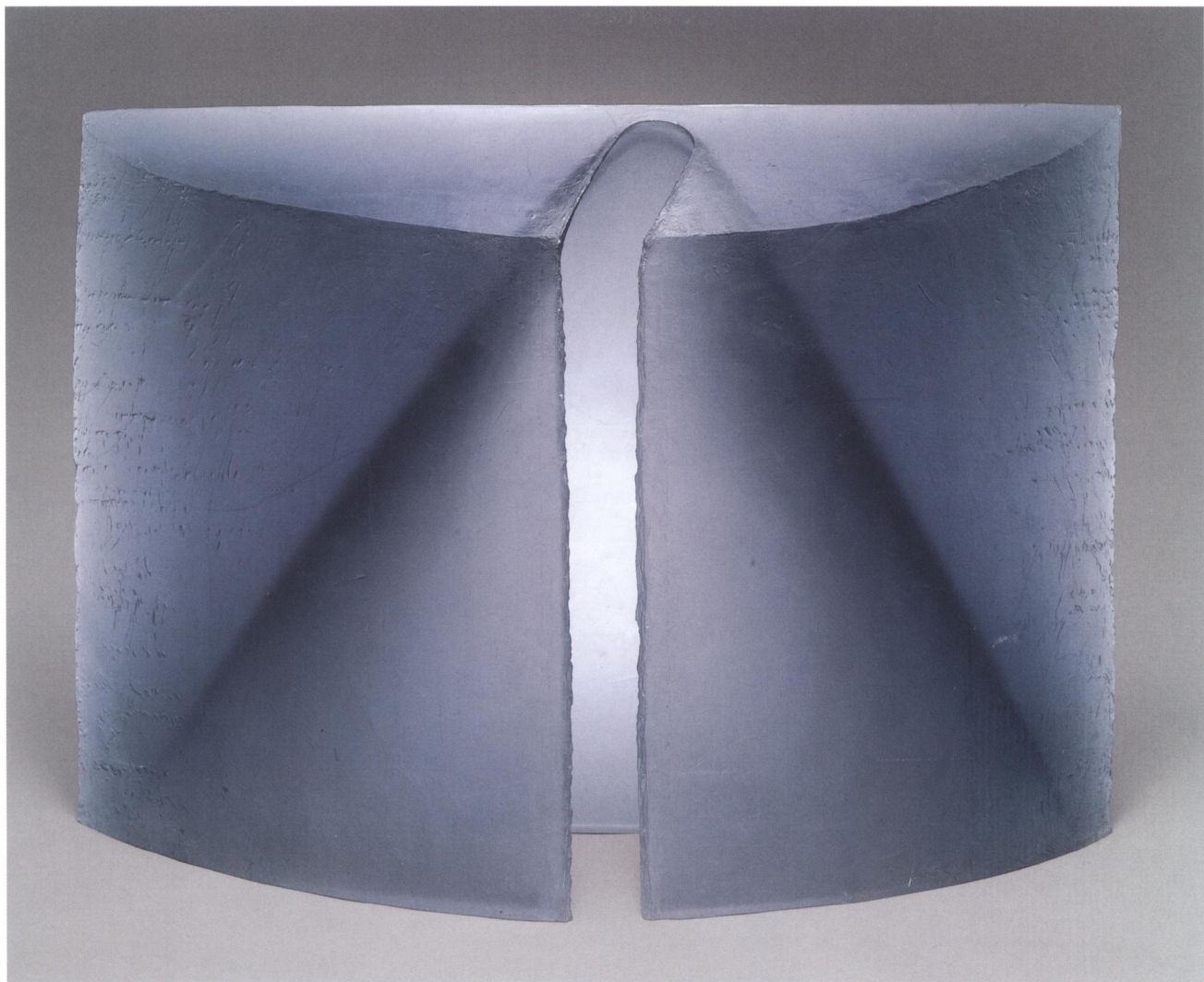


BANDED FLAIR

Tom Patti (American, b. 1943). 1977. Laminated glass, blown and cut. H. 4¾ in. (12 cm). Gift of Douglas Heller and Josh Rosenblatt, 1978 (1978.25)

Tom Patti was trained as an industrial designer in the 1960s. His first encounter with glass as an artistic medium came in the early 1970s, after attending a glassblowing session at the Penland School of Crafts in North Carolina. He began experimenting with salvaged industrial sheet glass as an economy measure: stacking it in layers, fusing the sheets together, and blowing air pockets into the solid mass to create a vessel form. A desired effect of this laminating technique was that the finished work retained a clear and intended visual reference to the method by which it was made.

Banded Flair is fluted and spherical, with a square lip, horizontal banding, and projecting ridges at the sides of the neck. After laminating several sheets of pale-colored, translucent glass, Patti blew the cavity and cut and polished the overall form. It is his ability to adapt processes usually associated with industry to the creation of nonutilitarian works of fine art that sets him apart from both production-line glass designers and craftsmen or studio artists. His small-scale sculptures, usually done in series, become sensuous forms, miniature architecture, or studies in geometry. **JA**



VESTMENT II

Stanislav Libenský (Czech, b. 1921) and Jaroslava Brychtová (Czech, b. 1924). 1997. Cast glass. W. 39½ in. (100.3 cm). Purchase, Heller Gallery Gift, and Drs. Myra J. and Harold Weiss, Mr. and Mrs. John T. Kotelly, George F. Russell Jr., Gerard L. Cafesjian, and Geoffrey J. Isles Gifts, 1999 (1999.91)

The tradition of glassmaking in the Czech Republic spans many centuries—from the medieval era through the booming Bohemian export industry of the eighteenth and nineteenth centuries to the country's current position as a leading center for cutting-edge studio glass. After World War II, artists in the former Czechoslovakia were isolated from new trends and technologies developing in the West. For the past fifty years, however, despite the long-unfavorable political climate and the scarcity of materials, Stanislav Libenský and Jaroslava Brychtová have been extremely influential in the international studio-glass movement. In the 1940s Brychtová made *pâte de*

verre vessels, sculptures, and plaques, and Libenský produced enameled and acid-etched tableware. By the late 1950s, the couple had begun to experiment with larger scale and abstract forms, collaborating on architectural screens and nonfigurative sculptures.

Vestment II consists of gray glass cast in a mold. Its minimalist form is reminiscent of a liturgical garment, yet the piece remains essentially an abstraction of light and color in space. The depth of the glass and its graduated color respond to the changes in and movement of light around it, so that the piece can appear opaque and grandiose but at other times almost weightless. JA

TECHNICAL EXAMINATION AND CONSERVATION OF GLASS

The activities involved in the technical examination and conservation of glass at The Metropolitan Museum of Art take place in the Sherman Fairchild Center for Objects Conservation, where conservators and scientists examine objects in the Museum's collections and those being considered for acquisition to determine their methods of manufacture and chemical compositions, as well as any damage or deterioration they may have undergone. The conservators may then perform treatments, such as cleaning, repair, and restoration. They also recommend appropriate conditions for the storage, exhibition, and transportation of objects.

The first step in any conservation treatment is careful visual examination of the object under a variety of lighting conditions or under low magnification, which can reveal important evidence of the method of manufacture. For example, almost all preindustrial glasses contain some bubbles that were trapped in the molten glass as it cooled. In cast-glass vessels, these bubbles exhibit their natural spherical shape. Manipulation of molten glass by pulling or blowing, however, deforms the bubbles temporarily; thus, in blown glass, which cools faster than cast glass, they are often elongated and oriented in the direction of the action taken in forming the vessel.

Visual examination can also provide information about the order in which different steps occurred in the manufacturing and subsequent aging of a glass object. In some instances, the hand of the forger, or overzealous restorer, is revealed. For example, the decoration on a heavily damaged and restored enameled and gilded plate in the Department of Islamic Art (acc. no. 54.107) was found to overlies scratches and pits in the weathered glass; some enamel was even discovered on the edge of one of the fragments (see fig. 1). These anomalies indicate that the decoration was applied well after the weathering and damage occurred. Chemical analysis of the glass and the enamels suggests that the plate is an authentic medieval Islamic work that was decorated in the late nineteenth or early twentieth century to make it more attractive for sale.

The classification and dating of glass is based in part on its chemical composition. Unlike for organic materials and fired ceramics—which can be analyzed by radiocarbon dating and thermoluminescence, respectively—there are no objective methods of dating ancient or historic glass other than analysis of its chemical composition. For the last forty years or so, scientists around the world have been building up a large body of data that reveal the various changes in glass compositions over nearly five thousand years of production. The identification of the overall

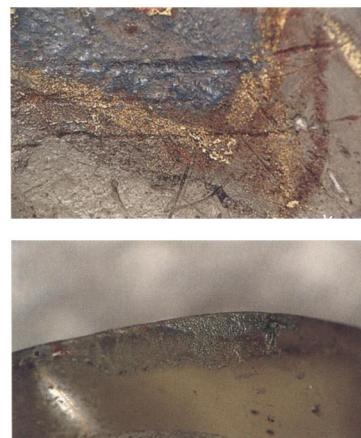


Figure 1
Details of Islamic plate
(acc. no. 54.107)
showing (top) gold and
enamel applied over
scratches and pits and
(bottom) green enamel
overlapping edge of
fragment

composition of an individual glass, as well as of the compounds used to color and/or opacify it, can help conservators determine its approximate date or place of origin.

For more than ten years, the laboratory at the Metropolitan Museum has been one of the few in the world that routinely performs reliable quantitative analyses of ancient and historic glass and vitreous materials with an in-house scanning electron microscope (SEM) and energy-dispersive X-ray spectrometer (EDS). Recently, a wavelength-dispersive X-ray spectrometer (WDS) was acquired, which allows for better trace-element analysis than by EDS alone. X-ray microanalysis with the SEM is a non-destructive technique, and surface analyses can be performed directly on small objects and fragments. However, for precise quantitative analysis of glass it is necessary to take a sample of the object. No more than about one cubic millimeter, less than half the size of a grain of rice, is required. Aside from this small sample size, the advantages of X-ray microanalysis include relatively quick results and the ability to analyze separate phases within a single sample, such as the remaining portion of intact glass in a badly weathered fragment (see fig. 2). Compositional analysis has been responsible for definitively identifying some modern reproductions of ancient objects and has also helped to reevaluate the geographical origin of certain objects (for example, the Chinese bowl on p. 26). In the years since glass analysis was first undertaken at the Metropolitan Museum, hundreds of individual objects from its collection and elsewhere have been chemically analyzed, and ongoing research projects involving the laboratory equipment include studies of early Egyptian glass, Roman-era glass vessels and mosaics, and medieval and Renaissance enamels.

Once the technical examination has been completed, a decision is made about which, if any, conservation treatments are required. Even a simple cleaning entails the permanent removal of material and must not be undertaken lightly. Glass vessels may retain traces of their original contents (such as perfume, oil, or medicine) or accretions of foreign material that may provide evidence of their burial environment. The action of water on glass over time can lead to the formation of iridescent or opaque corrosion layers. In the past, it was common to remove such corrosion from ancient glass in order to restore its translucency. Of course, it is not possible to return corroded glass to its exact original condition, because the removal of the corrosion layer exposes glass that had been below the surface and leaves the object thinner and more fragile. Today, corrosion products on glass are considered evidence of the object's archaeological history and are generally retained. Indeed, when corrosion is flaking, it is now typically consolidated with dilute adhesives.

Rare exceptions to this rule are made under unusual circumstances. For example, examination under magnification of the garland bowl on page 21 indicated that it had

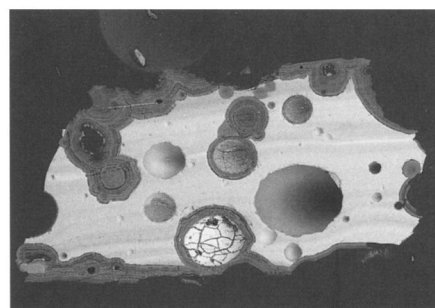
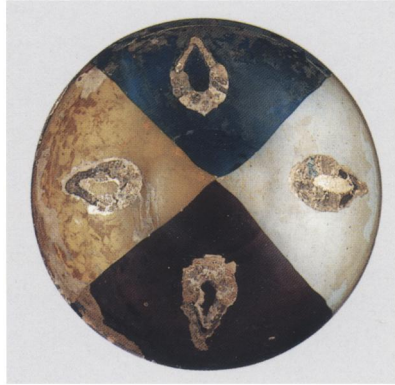


Figure 2
Scanning electron micrograph of cross-sectioned sample of corroded Roman-era glass (gray areas at the edges indicate weathered crust)

Figure 3
Interior of garland bowl
before cleaning (acc.
no. 91.1.1402; see
post-conservation view
on p. 21)

once been completely covered with corrosion products, which had either flaked off or been intentionally removed everywhere except directly over the garlands. On the inside of the bowl, the garlands were still completely obscured by opaque beige corrosion (see fig. 3), but they could be seen from the underside of the bowl through the translucent glass. Because of the object's uniqueness and the fact that it was not in its "as excavated" condition, curators and conservators decided to remove the remaining corrosion. The layers were carefully peeled away with a scalpel under the microscope, revealing the stunning decoration.



Glass objects, which are very susceptible to breakage, have been repaired since antiquity with a variety of adhesives and mechanical joins, including animal-based glues, nitrocellulose, and metal wires or staples. Much of modern conservation involves the removal of old treatments and restorations that are now structurally unstable or that obscure or distort the appearance of the object. The translucency of glass posed a particularly difficult problem for past restorers. The modern era of glass conservation could be said to have begun with the development of clear and colorless adhesives, which gave conservators the means to make strong, stable, and nearly invisible repairs. Polymers of various types, including polyesters, acrylics, and epoxies, have each been introduced into the field in their turn. Today's conservators have at their disposal materials that are not only strong and aesthetically pleasing but that maintain their appearance and reversibility over a long period of time, making the work of future conservators easier.

One of the most important aspects of conservation is the maintenance of safe and stable conditions for storage and exhibition. "Passive conservation" is as important as active treatment, if not more important, for the long-term preservation of objects. For most glass objects, a stable relative humidity near fifty percent, a temperature consistently in the range of twenty-five degrees centigrade, and a dust-free environment are sufficient. Some types of glass with inherently unstable compositions, however, will deteriorate relatively rapidly even in controlled museum conditions. When water vapor in the air adsorbs (adheres in a very thin layer) to the surface of these glasses, dissolving their alkali components, they are described as "sweating" or "weeping." When the air becomes drier, the adherent liquid evaporates and a fine network of cracks is revealed—a phenomenon known as "crizzling." Repeated fluctuations in the relative humidity can cause flakes of glass to detach from the surface and can eventually destroy an object. The search for optimal storage conditions, as well as for treatments for this so-called glass disease, is one of many ongoing challenges in the field of glass conservation.

Lisa Pilosi and Mark T. Wypyski

The Metropolitan Museum of Art Bulletin Index

Summer 2001–Spring 2002 New Series, Volume LIX

A

Ars Vitraria: Glass in The Metropolitan Museum of Art, No. 1, 1–68

alabastron: Mesopotamian (7th–6th cen. B.C.), 19; probably Phoenician (late 8th–6th cen. B.C.), 19

Amelung, John Frederick, 54

Art Deco, 62

Art Nouveau, 61, 62

L'arte vetraria (The Glassmaker's Art), 42

aryballos and two oinachoi (Greek, Hellenistic per., late 4th–early 3rd cen. B.C.), 20

Augustus (Roman emperor), 18, 21

Bakewell, Page and Bakewell: decanter (American, ca. 1826), 54

Barovier, Angelo, 42, 46

Baur II, Matthäus: covered goblet (South German, ca. 1695–1700), 48

Beauneveu, André, 36

belt plaques (China, Ming dyn., 15th–16th cen.), 26, 27

Blumka, Leopold, 40

Boshan. *See* Zibo

Boston and Sandwich Glass Co.: celery vase (American, 1830–40), 55

Boston and Sandwich Glass Co., New England Glass Co., or South Boston Flint Glass Works: sugar bowl (American, 1820–35), 55

bottle: and sugar bowl (American, 1820–50), 57; barrel-shaped (Roman, late 2nd–early 3rd cen. A.D.), 24; pocket (American, 1769–74), 57

Bousch, Valentin, 45

bowl(s): faceted (possibly Iran, Sasanian per., 5th–7th cen. B.C.), 10; footed (Venetian, ca. 1500–1525), 42; garland (Roman, Late Republic or Augustan per., late 1st cen. B.C.), 21; “onyx” (Greek, Hellenistic per., 2nd–early 1st cen. B.C.), 21; opaque blue (China, Yuan dyn., 13th–14th cen.), 26–27

box, cosmetic (Egyptian, Dynasty 26–early Ptolemaic per., ca. 664–300 B.C.), 15

Brychtová, Jaroslava, 65. *See also* Libenský, Stanislav

Cassius, Andreas, 48

Chihuly, Dale: Campo della Salute chandelier, 5

Circle of the Master of the Koula Beaker: covered beaker (Austrian, 1690), 48

cleaning, of corroded glass objects, 67–68

closed-glass liquid thermometer, 7

cold-working, 4

conservation, passive, 68

Corning Glass Works, 62

crizzling, 68

Cros, César-Isidore-Henri: relief plaque of Pasiphaë (ca. 1895), 50

cup: footed (Egyptian, New Kingdom, Dynasty 18, 1390–1352 B.C.), 13; relief-cut (Iran, 9th cen.), 29

Dean, Bashford, 51

dish (India, early 18th cen.), 32

Dorflinger, Christian, 56

energy-dispersive X-ray spectrometry (EDS), 67

Ennion, 22

Exposition des Arts Décoratifs et Industriels, 64

façon de Venise, 40, 42

faience, 11, 12, 15, 17

Favrile glass, 53, 58

figure-vase fragment (Egyptian, New Kingdom, later Dynasty 18, ca. 1425–1295 B.C.), 15

flask, slender, with handle (Egyptian, New Kingdom, later Dynasty 18, 1400–1295 B.C.), 13

“forest glass,” 7

Franklin, Benjamin, 52, 54

Gallé, Émile, 58, 60. Work: “Autumn Crocus” vase (ca. 1900), 61

goblet(s): button-based (Near Eastern, mid-15th cen. B.C.), 12;

dragon-stem (probably South Netherlandish or German, 17th cen.), 42, 43; inscribed (Roman, 4th–early 5th cen. A.D.), 23; narrative (Venetian, ca. 1485), 46; two (possibly Syria, 10th–11th cen.), 29

Gobrecht, Christian, 54

grisaille panels (France, ca. 1240–45 and ca. 1265), 35

Gudenrath, William, 4

Hald, Edward: “Fireworks” vase (1921), 63

Havemeyer, H. O. and Louisine, 58

Hemmel, Peter, 39

Hoffmann, Josef, 61. *See also* Jungnickel, Ludwig Heinrich

Hopfinger, Otto, 40

hot-working, 4

inlays and shrine elements (Egyptian, Ptolemaic per., Dynasty 30, ca. 380–30 B.C.), 16

jar, footed, and lotiform chalice (Egyptian, New Kingdom, Dynasty 18, 1479–1425 B.C.), 12

Jarves, Deming, 55

Jarves, James Jackson, 45

jug: majolica-like (Venetian, ca. 1500–1510), 41; opaque blue (Roman, Augustan or Julio-Claudian per., late 1st cen. B.C.–early 1st cen. A.D.), 23

Jungnickel, Ludwig Heinrich, and Josef Hoffmann: wineglass (1910–11), 61

Kreischman[n], Fredolin, 58

Kunckel, Johann, 48

La Farge, John, 59

Labino, Dominick, 60

Lalique, René Jules: “Haute Vigne” cup (1912), 62

Laurent, Claude: transverse flute in D (1813), 52

Leighton, Thomas, 56

Libenský, Stanislav, and Jaroslava Brychtová, 65. Work: *Vestment II* (1997), 65

Littleton, Harvey, 60

Long Island Flint Glass Works: presentation vase (American, 1859), 56

Louis XII, 41

Madonna of the Apocalypse (Germany, ca. 1430–35), 37

Marinot, Maurice, 60. Work: flask with stopper (French, 1923), 64

Meyer, Johann Heinrich: wineglass (German, ca. 1720–30), 47

Mitelli, Giuseppe Maria: engraving, 6

mosque lamp (Egypt, ca. 1350–55), 31

Mother of Sorrows (Mater Dolorosa) (Strasbourg Workshop-Cooperative, Lautenbach Master, ca. 1480), 39

Nativity and Crucifixion with Saints (medallion attached to reliquary monstrance of Saint Mary Magdalen) (Italy, ca. 1375–1400), 36

Neri, Antonio. *See* *L'arte vetraria*

New Bremen Glass Manufactory: covered goblet (pokal) (American, 1788), 54

New England Glass Co.: presentation vase (American, 1843), 56. *See also* Boston and Sandwich Glass Co.

pâte de verre, 50

Patti, Tom: *Banded Flair* (1977), 64

Perrot, Bernard, 49

pitcher and two bottles (probably Iran, 9th–12th cen.), 30

plaque(s): floral (Egyptian, Roman per., late 1st cen. B.C.–1st cen. A.D.), 17; inlay, framed (Syria, 8th cen. B.C.), 9; inlay, unframed (Mesopotamia, 8th cen. B.C.), 9

plate (Egypt, ca. 1350–75), 31

Prophet (fragment of a window) (France or South Lowlands, ca. 1390–1410), 36

Ravenscroft, George, 5

Roemer (Dutch, early 17th cen.), 46

Saint Michael and a Donor (French, ca. 1500), 51

scanning electron microscopy (SEM), 67

scenes from the life of Christ (Austria, ca. 1390), 37, 38

Schaper, Johann: beaker (German, 1664), 47

Shaykhū al-ʿUmārī (great emir), 31

small-sword (French, 18th–19th cen.), 51

Smith, Francis Hopkinson, 52

Sorgheloos in Poverty (North Lowlands, 1510–20), 39

South Boston Flint Glass Works. *See* Boston and Sandwich Glass Co.

spa glass (French, 1726), 49

stained glass, 33–35, 37–39

statuette, of goddess Taweret (Egyptian, Ptolemaic per., 332–30 B.C.), 17

Stiegel, Henry William, glassworks of: pocket bottle (American, 1769–74), 57

studio-glass movement, 7, 60

Stumpf, Kilian, 27

tankard (French, 1716), 49

tazza: armorial (probably Venetian, possibly French, 1499–1514), 41;
 armorial, with jug (Venetian, ca. 1513–34), 44
Theodosius Arrives at Ephesus (scene from *Legend of the Seven Sleepers*)
 (France, ca. 1200–1205), 34
 Tiffany, Louis Comfort, 53, 58, 59
 Tiffany Furnaces: bowl (American, 1908), 58
 Tiffany Glass and Decorating Co.: peacock vase (American,
 1893–96), 58; vase (American, 1893–98), 58
 vase: and jug and cup signed by Ennio (Roman, Julio-Claudian per.,
 1st half of 1st cen. A.D.), 22; in shape of pomegranate
 (Egyptian, New Kingdom, Dynasty 19–20, ca. 1295–1070
 B.C.), 14; opaque blue (China, Qing dyn., Qianlong per.,
 1736–95), 27
 Venetian glass, 7, 40, 41, 42, 44, 45, 46
 Vershinin, Aleksandr Petrovich: beaker (ca. 1800), 49, 50
 vessel, with two handles (Mesopotamia or Iran, Sasanian per., 4th–5th
 cen. B.C.), 10
 Waugh, Sidney Biehler: “Gazelle” bowl (1935), 62
 wavelength-dispersive X-ray spectrometry (WDS), 67
 Whitney, Henry, 56
 Wiener Werkstätte, 61
 Wright, Frank Lloyd: triptych from the Avery Coonley playhouse
 (American, 1912), 59
 X-ray microanalysis, 67
 Zibo (formerly Boshan), 25, 27

G

Gold of the Americas, No. 3, 1–56
 Atawalpa (Atahualpa), 4
 Aztec empire, 4–6
Aztec Metalworker (illustration from facsimile of Codex Mendoza
 [1541–42], fol. 70), 6
 beads: head-form (Peru [Moche], 3rd–6th cen.), 15; insects?
 (Colombia [Malagana], 3rd cen. B.C.–3rd cen. A.D.), 14, 15;
 with supernatural figure (Peru [Moche], 3rd–6th cen.), 15
 beaker(s): two, with upside-down faces (Peru [Lambayeque],
 10th–11th cen.), 35; with figure displaying a shell (Peru
 [Lambayeque], 10th–11th cen.), 36; with repoussé figure
 (Peru [Lambayeque], 10th–11th cen.), 35
 bell, deer-head (Costa Rica [Chiriquí], 11th–16th cen.), 49
 bell ornament (Mexico [Mixtec/Aztec], 15th–16th cen.), 4
 Charles V of Spain (Holy Roman emperor), 4
cire perdue. See lost-wax method
 Columbus, Christopher, 3–4
 Cortés, Hernán, 4, 54–55
 crown (Peru [Lambayeque], 10th–11th cen.), 13
 dance wand, with face (Peru [Nasca], 1st–2nd cen.), 30
 depletion gilding. See *mise en couleur* process
 diadem, with caiman (Colombia [Middle Magdalena], 1st–7th cen.),
 13
 Díaz del Castillo, Bernal, 54–55
 Dürer, Albrecht, 4
 earflares, pair of: with condors (Peru [Moche], 2nd–3rd cen.), 18;
 with multifigure scene (Peru [Chimú], 12th–15th cen.), 17;
 with winged runners (Peru [Moche], 2nd–5th cen.), 16
 ear ornaments, pair of (Colombia [Yotoco], 1st–7th cen.), 16
 ear rods, pair of (Panama [Macaracas], 8th–12th cen.), 39
 Española (Hispaniola), 3, 4
 Echenique Plume, the. See plume or pin, ornamented
 Ferdinand (king of Spain), 3
 figure pendant(s): animal-headed (Colombia [Qimbaya?], 7th–10th
 cen.), 22, 23; animal-headed (Colombia [Yotoco or
 Qimbaya], 1st–7th cen.), 22; bat-nosed (Costa Rica
 [Diquís], 13th–16th cen.), 50, 51; *cacique* (Colombia
 [Taírona], 10th–16th cen.), 27; costumed (Colombia
 [Tolima] 1st–7th cen.), 28; crocodile-masked (Panama
 [Veraguas], 11th–16th cen.), 52; crocodile-headed (Costa
 Rica [Chiriquí], 11th–16th cen.), 53; deer-headed (Costa
 Rica [Chiriquí], 11th–16th cen.), 49; double bat-nosed
 (Panama [Chiriquí], 11th–16th cen.), 50, 51; double bat-
 nosed (Panama [Parita], 12th–16th cen.), 50, 51; double
 crocodile-headed (Panama [Veraguas], 11th–16th cen.), 52;
 masked (Colombia [Taírona], 10th–16th cen.), 26, 27;
 masked, two (Colombia [Yotoco], 1st–7th cen.), 22; styl-
 ized, two (Panama [International style], 5th–7th cen.), 41
 hammering, 7
 headdress frontal: with face (Colombia [Yotoco], 1st–7th cen.), 10,
 11; with faces (Peru [Sihuas], 3rd cen. (?)), 10; with feline
 face (Peru [Moche], 3rd–6th cen.), 12
 Inka empire, 4, 5
 Isabella (queen of Spain), 3
 knife, ceremonial (*tumi*) (Peru [Lambayeque], 10th–11th cen.), 34, 35
 lime container (*poporo*) (Colombia [Quimbaya], 1st–7th cen.), 33
 lime dipper or pin: with bird (detail) (Bolivia [Tiwanaku], 5th–10th
 cen.), 32; with bird and grinning creature (Colombia
 [Yotoco], 1st–7th cen.), 32
 lost-wax method (*cire perdue*), 7, 27
 mask: funerary (Peru [Lambayeque], 10th–11th cen.), 37, 38; puffy-
 cheeked (Colombia [Ilama], 4th–2nd cen. B.C.), 8, 9
Merchant Ship (woodcut [detail] from *Perigrinatio in terram sanctam*,
 by Bernhard von Breydenbach, 1486), 3
 mining: placer (panning), 6; underground, 6
mise en couleur process, 7, 45
 Motecuhzoma (Montezuma II), 4, 54–55
 Naymlap, 35
 necklace (detail) (Colombia [Yotoco], 1st–7th cen.), 14, 15
 nose ornament: Central American (Panama [Venado Beach], 5th–8th
 cen.), 39; in form of human head (Peru [Moche], 2nd–3rd
 cen.), 18–19; with birds (Peru or Ecuador, 2nd–3rd cen.),
 20; with cats (Peru [Vicús], 3rd–5th cen.), 21; with “cat’s”
 whiskers (Colombia [Sonso], 13th–16th cen.), 20; with
 crocodiles or lizards (Colombia [Sinú], 5th–10th cen.), 21;
 with fantastic face (Peru [Vicús], 3rd–5th cen.), 21; with
 intertwined serpents (Peru [Moche], 2nd–3rd cen.), 18, 19;
 with spiders (Peru [Salinar?], 1st cen. B.C.–1st cen. A.D.), 9;
 with spirals and spheres (Ecuador [Tolita], 1st–5th cen.), 18
 ornaments: earflare, pair of (Mexico [Mixtec/Aztec], 15th–early 16th
 cen.), 54, 55; feathered-serpent, two (Mexico [Toltec?/
 Chanal], 13th–15th cen.), 55; frog (Mexico [Mixtec/Aztec],
 15th–early 16th cen.), 54, 55
Panning Gold in the Early Colonial Period (woodcut, from *La historia
 general y natural de las Indias*, by Gonzalo Fernández de
 Oviedo y Valdés, 1535), 6
 pectoral disk (Panama [Veraguas?], 11th–16th cen.), 39
 pectoral: T-shaped (Colombia [Sonso], 13th–16th cen.), 28, 29; with
 face (Colombia [Yotoco], 1st–7th cen.), 10, 11; two-way
 (Peru [Chavín], 6th–2nd cen. B.C.), 4
 pendant(s): anthropomorphic (Colombia [Tolima], 1st–7th cen.), 28;
 composite (Panama [International style], 5th–7th cen.), 41;
 curly-tailed animal, two (Panama [Initial style], 2nd–7th
 cen.), 40; double bird (Panama [Macaracas], 8th–10th cen.),
 42; double crocodile (Panama [Macaracas], 8th–10th cen.),
 43; double eagle (Colombia [Muisca], 10th–16th cen.), 24,
 25; double eagle (Panama [Initial style], 2nd–7th cen.), 38;
 double eagle (Panama [Veraguas], 11th–16th cen.), 44;
 double insect (Panama [Macaracas], 8th–10th cen.), 42;
 eagle (Costa Rica, 11th–16th cen.), 7; eagle (Panama or
 Costa Rica [Chiriquí], 11th–16th cen.), 45; eagle (Panama
 [Veraguas], 11th–16th cen.), 45; frog (Costa Rica [Chiriquí],
 11th–16th cen.), 46; frog (Panama [Chiriquí?], 11th–16th
 cen.), 46; frog (Panama [Parita], 12th–16th cen.), 46;
 linear (Colombia [Capulí], 4th–10th cen.), 30; shark,
 two (Panama [Chiriquí], 11th–16th cen.), 48; turtle,
 three (Panama [Veraguas], 11th–16th cen.), 47; with bird
 (Colombia [Muisca], 10th–16th cen.), 24, 25
 Pizarro, Francisco, 4
 plaque, oval (Argentina [Condorhuasi], 1st–7th cen.), 30
 plume or pin, ornamented (the Echenique Plume) (Peru [Pukara],
 2nd cen. B.C.–2nd cen. A.D.), 31
 Polo, Marco, 3
 Sicán, Lord of, 35
 staff head, with owl (Colombia [Sinú], 5th–10th cen.), 33
 standing figure, wearing nose ornament (Ecuador or Colombia
 [Tolita-Tumaco], 1st–4th cen.), 7
tumbaga, 7, 24, 26, 44
 votive object (*tunjo*) (Colombia [Muisca], 10th–16th cen.), 5
 Xochipilli (god), 55

J

Jones, Julie. See **Gold of the Americas**

K

King, Heidi. See **Gold of the Americas**

L

Lawson, Margaret. See **Picturing the Apocalypse**

P

Picturing the Apocalypse: Illustrated Leaves from a Medieval Spanish Manuscript, No. 4, 1–56

acanthus plant (*Acanthus mollis*), 13
 acanthus motif, 12, 35, 46
 Adoptionism, 6
 Alexander III (pope), 11
 Alfonso II (king of Spain), 17
 Alfonso III (king of Spain), 17
 Alfonso VI (king of Spain), 12
 Anglo-Byzantine style, 18, 29, 35, 46
 Antichrist, the, 7, 43
 apocalyptic literature, 5
 Apocalypse manuscripts, 5, 6, 7
 Apocalypse, the, 3, 5, 17, 18, 45
 apostle figure, west facade, Church of Santiago (Spanish, 1170–80), 27
 Arca Santa of Oviedo (detail) (Spanish, late 11th or early 12th cen.), 11
 Beatus manuscripts, 6–7, 8, 9, 43
 Beatus of Liébana, 6, 7, 43
 Bible: Book of Revelation, 5; Bury, 12, 23; Cardeña, 23, 31; Dover, 12; Jerome's Latin Vulgate, 5
 blast horn (oliphant) (Southern Italian, 10th–11th cen.), 31
 book cover, with icon of Crucifixion (panel: Byzantine, 2nd half of 10th cen.; setting: Spanish, before 1085), 13
 Byzantine art, 7, 11, 12, 18, 23, 53
 Cardeña Beatus. *See Commentary on the Apocalypse by Beatus of Liébana* (Cardeña Beatus)
 Carroll, Robert, 51
 casket (detail) (English, ca. 1150), 13
 Christ in Majesty, figure of, west facade, Church of Santiago (Spanish, 1170–80), 10
 Cluniac influence: in painting, 12; in sculpture, 9; on liturgy, 9, 12
 column figures of Saints Peter and Paul, Chapel of San Miguel, Cámara Santa, Oviedo Cathedral (Spanish, 1165–75), 11
Commentary on the Apocalypse by Beatus and Commentary on Daniel by Jerome (Manchester Beatus) (Spanish, late 12th cen.), 31, 45, 46; illustrations from, 31, 46
Commentary on the Apocalypse by Beatus of Liébana (Cardeña Beatus) (Spanish, ca. 1175–80), 8–46; Adoration of the Magi miniature in, 12, 18, 21, 23; Antichrist table in, 42, 43, 50; Christ in Majesty illustration in, 11, 22, 23, 27, 37, 39; frontispiece of, with alpha and omega, 16, 17; genealogical tables in, 18, 19–21; illustrations from, 4, 9, 14, 16, 19, 20, 21, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 44, 51, 52, 53, 54; techniques and materials of, 47–54
Commentary on the Apocalypse by Beatus of Liébana (Girona Beatus) (Spanish, 975), 43; Antichrist table from, 43
Commentary on the Apocalypse by Beatus of Liébana and Commentary on Daniel by Jerome (Morgan Beatus) (Spanish, mid-10th cen.), 7, 9, 15, 25, 27, 29, 31, 33, 37, 39, 41, 43, 45, 53; illustrations from, 15, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 45
 composite style, 10–11, 25, 39
 conservation practices at the MMA, 47
 Cross of Victory, 17
 cross plaque, with Lamb of God and symbols of Evangelists, from book cover (Southern Italian, 975–1000), 5
The Crucifixion, from a lectionary (French, early 12th cen.), 12
 Crucifixion group (Spanish, late 12th cen.), 11
 “damp-fold” manner or substyle, 9, 10, 11, 12, 23, 25, 27, 29, 31, 39, 53
 Dead Sea scrolls, 5
 descriptive manner. *See* pleated substyle
 Dragon (detail) (Spanish, 1200–1220), 6
 drapery, clinging. *See* “damp-fold” manner or substyle
 Eco, Umberto: *The Name of the Rose*, 43
 energy-dispersive X-ray spectroscopy (SEM-EDS), 49, 50, 51
 energy-dispersive X-ray fluorescence spectrometry (XRF-EDS), 49, 50, 51, 54
 English manuscript painting, 11, 23
 Enthroned Virgin and Child, from an Epiphany relief (Spanish, 3rd quarter of 12th cen.), 10, 29
 Eraclius: *De coloribus et artibus Romanorum*, 48
 Falcon (Southern Italian, ca. 1200), 35
 Ferdinand I (king of Spain), 12
The Fourth Trumpet, from the Cloisters Apocalypse (French, ca. 1320), 7
 Fructuosus (painter; Spanish?): *Ferdinand, Sancha, and the Scribe*, from the *Prayer Book of Ferdinand and Sancha* (Spanish, 1055), 8, 9, 11

Girona Beatus. *See Commentary on the Apocalypse by Beatus of Liébana* (Girona Beatus)
God the Father, from a Bible (Spanish, ca. 1175), 23
 Gregory VII (pope), 9
 Ibn Bādīs: *Book of the Staff of the Scribes*, 48
 ink, hawthorn, 51
 Islamic culture, 7–8
 Joachim of Fiore, 3
 John (prophet; apostle?), 5, 6, 7, 23, 25, 27, 43, 54
Kneeling King, from an Epiphany relief (Spanish, 3rd quarter of 12th cen.), 10
 Koehler, Wilhelm, 10
 Manchester Beatus. *See Commentary on the Apocalypse by Beatus and Commentary on Daniel by Jerome* (Manchester Beatus)
Mappae clavicula, 48, 51, 54
 Master Hugo: *Ezekiel's Vision of God*, from the Bury Bible, vol. 3 (English, ca. 1135), 23
 Master Mateo: Apostle James the Greater, figure of, trumeau of central portal, Pórtico de la Gloria, Cathedral of Santiago de Compostela (Spanish, 1168–88), 39; apostles, figures of, right jamb, central portal, Pórtico de la Gloria, Cathedral of Santiago de Compostela, 25
 Messiah, Handel's, 41
 mirror case, valve of (English, 1180–1200), 37
 Morgan Beatus. *See Commentary on the Apocalypse by Beatus of Liébana and Commentary on Daniel by Jerome* (Morgan Beatus)
 “Mozarabic” style, 8, 9, 13, 17, 35, 46
Noli me tangere (detail of reliquary plaque) (Spanish, ca. 1115–20), 41
 oliphant(s), 31, 37
 open-architecture X-ray diffraction (XRD), 49
 parchment, 50
 pleated substyle, 10, 12, 25, 31, 33, 37, 39, 41, 45, 53
 Romanesque style, 8, 13, 25, 37, 41, 46
 rubrics, 51
Saint Luke, from a Bible (French, ca. 1100), 12
Saint Michael's Battle with the Dragon (German, ca. 1020), 6
Saint Paul and the Viper (English, ca. 1163), 11, 18
 San Miguel de Escalada, interior (Spanish, 913), 15
 scanning electron microscopy (SEM), 49
 Theophilus: *De diversis artibus*, 48, 51
 treatises on painting, medieval, 47–48
 underdrawing, 52
 Wheeler, George, 49
 Williams, John, 8, 17, 45
 Wypyski, Mark, 49, 51
 X-ray diffraction (XRD), 49
 X-ray fluorescence (XRF), 49, 50, 51, 52, 54

R

Recent Acquisitions: A Selection: 2000–2001, No. 2, 1–88

“Africa, Oceania, and the Americas,” 72–75
 ancestor effigy (*rambaramp*) (Vanuatu, mid-20th cen.), 73
 corset, male (Sudan, 2nd half of 20th cen.), 75
Couple (Madagascar, 17th–late 18th cen.), 74
 Ellis, William: *Antsahatsiroa (Madagascar)* (1862–65), 72–73
 headdress ornament (Peru, 100 B.C.–A.D. 300(?)), 72
 mask (Indonesia, 19th–early 20th cen.), 73
 “Ancient World,” 8–13
 amphora (Roman, 1st cen. B.C.–1st cen. A.D.), 11
 bracelet, with central medallion (Greek, Hellenistic per., 2nd cen. B.C.), 10
 chariot or cart trappings (?) (provincial Roman, 2nd–3rd cen. A.D.), 11
 diadem, brooch, and armbands (Carpathian Basin, Late Bronze Age, 1200–900 B.C.), 8
 matron, Roman, portrait head of (Roman, ca. 40–20 B.C.), 12
 rhyton, with female head (probably Mesopotamia, late Parthian–early Sasanian per., 3rd cen. A.D.), 13
Siren (Greek, Archaic per., ca. 550–500 B.C.), 9
 situla (wine bucket), with two handles (Greek, Hellenistic per., late 4th–early 3rd cen.), 10
 sphinx, support in shape of (Greek, ca. 600 B.C.), 9
 “Asia,” 76–85
Bodhisattva Seated on a Lion (Chinese, Song or Jin dyn., 11th–early 13th cen.), 76
Dakiniten (Japanese, Nambokucho per., 1333–92), 80
 Gu Fang. *See* Wang Hui et al.
 initiation cards, twenty-five (*tsakalis*) (Tibetan, late 13th to mid-14th cen.), 83

- mandala of Han'nya Bosatsu (Japanese, Muromachi per., 16th cen.), 81
- plate (Chinese, Qing dyn., ca. 1st third of 18th cen.), 80
- saddle (*kura*) (Japanese, Edo per., 1658), 82–83
- Samuel Eilenberg Collection, a selection from (Southeast Asian, Bronze and Iron Ages, ca. 500 B.C.–A.D. 300), 84
- screen, twelve-panel (Chinese, Qing dyn., Kangxi per., late 17th cen.), 78, 79
- shield, cane, with iron fittings (Tibetan, 14th–16th cen.), 83
- Standing Female Deity* (Cambodian, Pre-Angkor per., style of Prasat Andet, ca. 4th quarter of 7th–beginning of 8th cen.), 85
- Wang Hui et al.: *Landscapes after Ancient Masters* (Qing dyn., Kangxi per., 1692), 77
- Wang Yun. *See* Wang Hui et al.
- Xu Mei. *See* Wang Hui et al.
- Yang Jin. *See* Wang Hui et al.
- Yasunobu, Kano: *Bugaku Dancers* (Japanese, Edo per., 1662–65), 82
- Zhang Jizhi: excerpt from “Song of Leyou Park” (Southern Song dyn., 1127–1279), 76–77
- “Europe 1700–1900,” 32–47
- Bonington, Richard Parkes: *View near Rouen* (ca. 1825), 35
- Bonvin, François: *A Woman Spinning Wool* (1861), 39
- Carpeaux, Jean-Baptiste: *Pietà* (1864), 38, 39
- Chapu, Henri: *Music* (ca. 1869), 37
- Courtois and Mille: valve trumpet (ca. 1881–85), 46
- Dantan, Jean-Pierre: bust of a young woman (1836), 36
- David d'Angers, Pierre-Jean: *Jeremy Bentham* (modeled ca. 1830, cast before 1844), 36
- Decoeur, Émile, or Edmond Lachenal: vase (ca. 1900–1905), 46–47
- Degas, Hilaire-Germain-Edgar: *Dancer* (ca. 1880), 42, 43; *Paule Gobillard, Jeannie Gobillard, Julie Manet, and Geneviève Mallarmé* (1895), 45
- Dresser, Christopher (designer): traveling tea set (ca. 1879), 39
- ewer, decorative (possibly Flemish, 1st half of 18th cen.), 32
- Fantin-Latour, Henri: *Asters and Fruit on a Table* (1868), 40; *Roses and Lilies* (1888), 41
- Gauguin, Paul: portfolio (1894), 44, 45
- Graf, Conrad: fortepiano (1838), 37
- Hukin and Heath (manufacturer). *See* Dresser, Christopher
- jug (French, ca. 1730–35), 33
- Lachenal, Edmond. *See* Decoeur, Émile
- Monet, Claude: *Poppy Field, Argenteuil* (1875), 42
- Nègre, Charles: *A Street in Grasse* (1852), 38
- Pistrucci, Benedetto: proof of sovereigns of George III (1817 and 1820), 34
- Reynolds, Sir Joshua: *Study of a Woman and Child* (n.d.), 34
- tobacco pipe, with original case (South German, ca. 1740), 33
- Vuillard, Edouard: *Album* (1895), 46–47
- “Islam,” 14–16
- Black Stork in a Landscape* (India, ca. 1780), 16
- bowl (western Asia, 9th cen.), 14–15
- box, inlaid (India, Mughal per., Indo-Portuguese style, late 16th–early 17th cen.), 15
- textile fragment (Egypt, 8th cen.), 14
- “Medieval Europe,” 17–20
- Balduccio, Giovanni di: *Relief with Saint Peter Martyr and Three Donors* (ca. 1340), 18–19
- cameo, with Fasting of Saint Nicholas (Southern Italian, 1200–1250), 17
- Christ and Apostles, two scenes of (Carolingian, ca. 850–900), 17
- cup, with trefoil handle (Bohemian, 3rd quarter of 14th cen.), 18
- Pietà* (Vesperbild) (Bohemian, ca. 1400), 20
- pilgrim's badge depicting shrine of Saint Thomas Becket at Canterbury Cathedral (English, 1350–1400), 19
- Prophet King*, from a Tree of Jesse window (German, 1260–70), 18
- “Modern,” 56–71
- Abakanowicz, Magdalena: *Figure on a Trunk* (2000), 69
- Beene, Geoffrey: evening gown (1993), 68–69
- Cézanne, Paul: *Still Life with a Watermelon and Pomegranates* (1900–1906), 56
- Dijkstra, Rineke: *Kolbrzeg, Poland* (1992), 67
- Dior, Christian (couturier). *See* Galliano, John
- Dix, Otto: *Nelly* (1924), 59
- Drew, Leonardo: *Number 24* (1992), 66
- Dubuffet, Jean: *Self-Portrait* (1936), 62
- evening wrap (French, 1918–20), 58
- Frank, Robert: *[The Congressional]* (1955), 63
- Galliano, John (designer): evening gown (2000), 68
- Hannock, Stephen: *The Oxbow: After Church, after Cole, Flooded (Flooded River for the Matriarchs E. & A. Mongan), Green Light* (2000), 70
- Hoffman, Josef: tea service (before 1911), 60
- Lawler, Louise: *Pollock and Tureen, Arranged by Mr. and Mrs. Burton Tremaine, Connecticut* (1984), 64, 65
- Lawrence, Jacob: *The Photographer* (1942), 62, 63
- Le Chevallier, Jacques: lamp (ca. 1928), 60
- Marden, Brice: *Red Line Muses* (2001), 70–71
- Matisse, Henri: *Seated Nude Asleep* (1906), 58
- Monet, Claude: *The Path through the Irises* (1914–17), 57
- Robsjohn-Gibblings, Terence Harold: Klismos chair (ca. 1937), 61
- Rohde, Gilbert: electric clock (ca. 1933), 61
- Segal, George: *Self-Portrait* (1998), 67
- Shapiro, Joel: *Untitled* (2000–2001), 71
- Smithson, Robert: *Bingham Copper Mining Pit—Utah Reclamation Project* (1973), 64
- Tanner, Henry Ossawa: *Flight into Egypt* (1923), 59
- Whitread, Rachel: *Untitled (Pair)* (1999), 66
- Winters, Terry: *Double Standard* (1984), 65
- “North America 1700–1900,” 48–55
- armchair, Masonic (Boston, 1760–75), 48
- Boston and Sandwich Glass Co., New England Glass Co., or South Boston Flint Glass Works: cream pitcher and sugar bowl (1820–35), 50–51
- earrings, with snap-on covers (American, ca. 1882–85), 54
- Fales Collection of American Jewelry, 54
- Guyol de Guiran, François: *Portrait of a Gentleman and His Daughter* (1800–1825), 50
- J. and I. Cox (designer, manufacturer, and/or retailer): lamp (ca. 1825), 51
- Jamison, George W.: cameo (New York City, ca. 1835), 54
- Miss Leland: *Boy with Pull Toy* (ca. 1825), 50
- locket (Boston, 1706), 54
- Lyon and Healy: pedal harp (ca. 1895), 52–53
- Marcus and Co.: brooch (American, 1892–before 1950), 54
- Richards, William Trost: *Lago Avernus* (ca. 1867–70), 52
- Stuart, Gilbert: *Captain John Gell* (1785), 49
- Tiffany, Louis Comfort: hair ornament (ca. 1904), 55; two vases (n.d.), 55
- Tiffany and Co.: pin (ca. 1837), 54
- Tiffany Glass and Decorating Co. *See* Tiffany, Louis Comfort
- Whistler, James McNeill: *Variations in Violet and Gray—Market Place, Dieppe* (1885), 53
- “Renaissance and Baroque Europe,” 21–31
- Beale II, Charles: *Carter, the Colorman* (1680), 30–31
- Brueghel, Jan, the Elder: *Landscape with Travelers on a Woodland Road* (ca. 1605–10), 29
- Callot, Jacques: *Study of a Horse* (ca. 1616), 28
- Cousin, Jean, the Elder: *Amya Petitioning Faustus for the Custody of Saint Mamas* (ca. 1543), 24, 25
- Gossaert, Jan: *The Holy Family* (ca. 1510–20), 24
- Heemskerck, Maarten van: *Man Protected by the Shield of Faith* (1559), 26
- Holbein, Hans, the Younger: *Saint Thomas* (1527), 23
- Kern, Leonard: *The Deposition* (ca. 1640–50), 31
- Leonardo da Vinci: *Studies for the Movements of Water, Male Nude Unsheathing a Sword, and Hercules Holding a Club Seen in Frontal View* (recto) (1506–8), 22; *Study for Hercules Holding a Club Seen in Rear View* (verso) (1506–8), 22
- Master i.e.: *Mary Magdalen* (ca. 1490), 24, 25
- Master of the Berswordt Altar: *The Flagellation* (ca. 1400), 21
- Pompeo della Cesa: portions of armor for Vincenzo Luigi di Capua, Prince of Riccia (ca. 1595), 27
- Rubens, Peter Paul: *A Sermon in a Village Church* (1630s), 30
- Scarsellino (Ippolito Scarsella): *The Virgin Adored by Saints* (ca. 1609), 28–29
- Wixom, William D. *See* **Picturing the Apocalypse**

W

Wixom, William D. *See* **Picturing the Apocalypse**