



United States Academic Decathlon®

Indian Hills High School - Oakland, NJ

ART

ART AND TECHNOLOGY

RESOURCE GUIDE

2023 - 2024

The vision of the United States Academic Decathlon® is to provide students the opportunity to excel academically through team competition.

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Introduction

The possibilities open to artists and architects have always been bounded by the tools, techniques, materials, and media available. As a creative expression of the human imagination, artmaking is incredibly reactive to new technologies, and artists are often able to rapidly incorporate innovations into their practices. While many inventions, like the printing press, have made the visual arts more cheaply available to all, others, like photography in the nineteenth century and conceptual art in the twentieth, have introduced radical new ways of understanding what “art” is and can be.

Many innovations in the arts that were revolutionary technologies during their era are today so integral to artistic practice that it is hard to imagine a time without them: technologies like oil paint, canvas, linear perspective, clear glass, and fine porcelain. In architecture, developments and discoveries such as the advent of concrete, the use of flying buttresses, perfected dome designs, and steel-frame skyscrapers are now the foundations upon which architects can advance new designs. This resource guide examines moments in the past when these new technologies emerged to help the reader better understand how technology reshaped the course of the visual arts specifically and human culture more broadly. In some, though not all, of these cases, we will closely examine a selected work of art that demonstrates the impact of these new technologies.

Hence the primary goal of this resource guide is to tell a very selective history of the visual arts from the singular lens of technological development. At every turn, we will seek to understand how new technologies changed the way art was made, appreciated, and conceptualized. Our approach in this resource guide will balance between two main categories: the first is technology that was important to the art world, like scientific advances in paint that allowed for new synthetic colors to be used in painting, or the

development of stained glass in the Gothic period; the second is technology that was important for huge swaths of the human population, artists included, such as the invention of the printing press, television, and the automobile.

As a necessarily abbreviated history, the guide focuses on the mediums of painting, sculpture, and photography, with some recourse to architecture, in order to better appreciate the long-term changes enacted by technological developments on these mediums. Taking a historical approach, the guide begins in the Roman Empire in 126 CE. and ends in the United States in the 1960s, long before the rise of the most significant technological advancement of recent times—the internet. Though its primary focus is to highlight and chronicle the history of technology in the Western art tradition, this guide also considers instances of global exchange—with China and Africa, for example. The latter parts of the guide focus exclusively on the art history of the United States in order to understand how technology changed the face of the arts in one place. This more focused approach leads to a deeper understanding of the entwining of art, technology, nationalism, culture, and politics.

In our contemporary moment, the arts are being transformed once again by the digital age. Today, artworks are created by people moving through laser beams or from the manipulation of data gathered on air pollution. Non-fungible tokens (NFTs)¹ have only recently opened up a whole new realm within the medium of digital art. Who can say where the next century of global history may take us. But one thing is certain: when we get there, the arts are sure to be thriving, just as they are now.

NOTE TO STUDENTS: Throughout the resource guide, you will notice that some terms have been boldfaced and

underlined. These terms are included in the glossary at the end of the resource guide. Also, students should be aware that dates in art history, especially early dates, frequently vary depending on the source and are often

highly contested. The dates presented in this resource guide are not necessarily definitive, but are those dates provided by the museums that house the artworks or the sources consulted by the author in writing this guide.

SECTION I

Art Fundamentals

INTRODUCTION TO ART HISTORY

Art history is an academic discipline dedicated to the reconstruction of the social, cultural, and economic contexts in which an artwork was created. The basic goal of this work is to arrive at an understanding of art and its meaning in its historical moment, taking into consideration the formal qualities of a work of art, the function of a work of art in its original context, the goals and intentions of the artist and the patron of the work of art, the social position and perspectives of the audience in the work's original time and place, and many other related questions. Art history is closely related to other disciplines such as anthropology, history, and sociology. In addition, art history sometimes overlaps with the fields of **aesthetics**, or the philosophical inquiry into the nature and expression of beauty; and **art criticism**, or the explanation of current art events to the general public via the press.

This brief introduction to the discipline of art history will help you understand the kinds of questions that one may ask in order to arrive at a deeper understanding of a work of art. We will put these ideas into practice as we proceed through case studies related to the specific topic of the resource guide.

Methods and Inquiries of Art History

Art historians today generally define “art” very broadly and include in their inquiries almost any kind of visual material that is created by people and invested with special meaning and/or valued for its aesthetic appeal. In the past, art historians often limited their focus to what was called “fine art,” which generally included paintings, prints, drawings, sculpture, and architecture, usually produced specifically for appreciation by an audience who also understood these objects as works of art. Today we define art much more broadly, also taking into consideration objects that in the past were dismissed as “craft”: textiles, pottery, and body art such as tattoos,

for example. Art historians also consider objects that might not be considered art by their intended audience, including mass-produced posters and advertisements and even the design of ordinary household items like telephones, forks, and the living room sofa.

Art historians acknowledge that the meaning of a work of art can shift over time, and that an artwork may be perceived differently by viewers who approach it from different perspectives. To give one hypothetical example, Michelangelo’s paintings on the ceiling of the Sistine Chapel would have certainly been significant in different ways in the eyes of 1) the Pope, who commissioned the work and who had sophisticated theological knowledge and nearly exclusive access to this private space within the Vatican and 2) a worker who was charged with cleaning the floors of the chapel and whose level of literacy was probably quite low. Differences such as social status, education, physical access to a work of art, religious background, race, and gender have an impact on the construction of the meaning of a work of art. Similarly, the paintings’ meaning to a twenty-first-century Protestant, Muslim, or atheist is certainly different from the meaning they had for a practicing Catholic in the sixteenth century, even though the works may be equally admired for their aesthetic value by all of these viewers. In other words, the meaning of a work of art is not fixed; it is sometimes open to multiple interpretations taking into consideration factors such as historical context.

The Nature of Art Historical Inquiry

Art historians generally analyze works of art in two ways that are distinct from one another, but also interrelated. These two modes of analysis are called **formal analysis** and **contextual analysis**. Formal analysis focuses on the visual qualities of the work of art itself. A basic assumption of formal analysis is that the artist makes decisions related to the visual aspects of the artwork that can reveal to us something about its

meaning. From this point of view, aspects of meaning are intrinsic to the work of art. Terms associated with the formal qualities of works of art, or the “elements of art,” are discussed in detail a bit later in this section of the guide. Formal analysis requires excellent skills in observation and description. Beginning our study of an artwork with formal analysis keeps the focus on the object itself, which to the art historian is always primary.

Contextual analysis involves looking outside of the work of art in order to determine its meaning. This involves examining not only the context in which the work was created, but also later contexts in which the work was and continues to be consumed. Contextual analysis focuses on the cultural, social, religious, and economic context in which the work was produced. Art historians may examine issues of **patronage**, viewer access to the work, the physical location of the work in its original context, the cost of the work of art, the subject matter in relation to other artworks of the time period, and so on.

Art history often emphasizes a chronological development with the assumption that within one cultural setting the work of one generation of artists will have an impact on following generations. Art historians often use comparative study. For example, by contrasting a Gothic with a Renaissance artwork, we can understand more clearly the unique features of each and the series of stylistic changes that led from one to the other. Then, we can seek to relate these changes to historical context. Art history provides information and insights that add background to the meaning and significance of the works of art we study. As we place these works of art in their cultural and historical context, they are connected to the long history of events that has led up to our present culture.

Sources, Documents, and the Work of Art Historians

Art historians often begin their analysis with a close examination of a work of art. Direct examination of the work of art is ideal because much is lost when we look at a reproduction rather than an original object. In the case of sculpture, it is often difficult to get a proper sense of the scale and the three-dimensional qualities of a piece from a photograph. We lose the texture and some of the rich colors when we experience paintings in reproduction. Even photographs can appear flatter, lacking their subtle transitions from light to dark

when seen reproduced in books. It is quite common, though, for art historians to settle for studying from reproductions due to practical constraints. In some cases, works of art might be damaged or even lost over time, and so art historians rely on earlier descriptions to aid in their formal and contextual analysis. In addition to examining the work of art in question, art historians will also seek to understand any associated studies (sketches, preparatory models, etc.) and other works by the artist and his or her contemporaries.

Art historians also use many written sources in the quest for contextual information about a work of art. Often these texts are stored in archives or libraries. Archival sources may include items such as letters between the artist and patron, or other documents pertaining to the commission, and art criticism produced at the time the work of art was made. An art historian might also search for written documentation about the materials used to produce the work of art, such as their cost and source, and about the function of the artwork—how a particular sculpture was used in ritual practice, for example. Art historians also seek to situate the work in the context of the literature, music, theater, and history of the time period.

Art historians may also rely on interviews with artists and consumers of works of art. This is especially the case in cultures that rely more on oral history than on written documents. Guided by the field of anthropology, some art historians also use methods such as participant observation to understand the context of a work of art. An art historian studying masquerade traditions in West Africa, for example, may participate in a performance while carefully documenting the event in order to better understand art traditions.

The Development of Art History

As an academic discipline, art history arose in the mid-eighteenth century. However, we can look at the work of much earlier writers to see how commentary on art has developed over time. The ancient Roman historian **Pliny the Elder** (23–79 ce) sought to analyze historical and contemporary art in his text *Natural History*. During the Renaissance, the author and artist **Giorgio Vasari** (1511–74) gathered the biographies of great Italian artists, past and present, in *The Lives of the Artists*. Vasari’s text provides us with insights into the changing roles of artists in society during this period and the developing concept of artistic genius.





Giorgio Vasari, self-portrait c. 1567.

Modern art history was strongly influenced by eighteenth-century Enlightenment philosophy. **Johann Joachim Winckelmann** (1717–68) was a German scholar who shifted away from Vasari's biographical emphasis to a rigorous study of stylistic development as related to historical context. Through the nineteenth and twentieth centuries, art historians continued to develop approaches that placed increasing emphasis on an understanding of the interrelationship between the formal qualities of a work of art and its context.

When considering contemporary views of art history as well as perspectives on art history from the past, it is important to keep in mind that all histories are individual stories and thus will inevitably reflect certain biases. More recently, art history has been revised, particularly by feminist historians, who have noted that the traditional version of art history has largely focused on white men, whether as artists or as patrons. As a result of such revisions, art history has expanded its scope in recent years and has become a field that is broader, more international, more multicultural, and more inclusive than in the past,

often involving Marxist, feminist, and psychoanalytic methods and viewpoints. Moreover, the concern with great artistic geniuses and masterpieces has lessened as the full range of “visual culture,” ranging from advertisement posters to film to photography and television imagery, has come to view.

BRIEF OVERVIEW OF THE ART OF THE WESTERN WORLD

This brief overview of Western art is intended to provide you with a basic understanding of important art historical periods as they developed chronologically. This abbreviated discussion also covers some key artistic innovations that occurred over time, providing you with examples of artists and works in their historical contexts. This basic information will set the stage for our more in-depth discussion of our case study focusing on art and technology. Of course, a brief guide such as this only begins to touch upon the richness and power of the stories that comprise the history of art. You may also enjoy looking at other works from each of the periods discussed, beginning your own exploration of these works in their historical contexts.

Much of what we know of the earliest life on earth has been revealed through a study of the objects or artifacts that remain from early cultures. In many cases, the objects that remain are those made of enduring materials such as stone, metal, or fired clay, as opposed to those made of perishable materials like wood or fibers. Environmental conditions also have a major impact on preservation. The hot dry climate of the desert in Egypt, for example, enabled the preservation of even delicate materials like papyrus, and the sealed atmosphere of Egyptian caves and tombs likewise helped to preserve the objects contained within them for our wonder and enjoyment centuries later. In contrast, the humid climate of West Africa means that objects made of perishable materials have had little chance of survival over the course of decades, not to mention centuries.

This is one reason that the history of art as a discipline has placed greater emphasis on Western cultures, often neglecting to focus on developments in Nonwestern cultures. It is important to recognize that the civilizations that are most often studied in art history courses are not necessarily those where the most or the best art was made. Rather, they are the civilizations whose art has been preserved and whose art has been discovered. There are, for example, many sites of

important civilizations in Central and South America that though known, remain yet unexplored. Too often the story at these sites has been one of exploitation and destruction, as people carelessly take artifacts to sell them on the international market in antiquities.

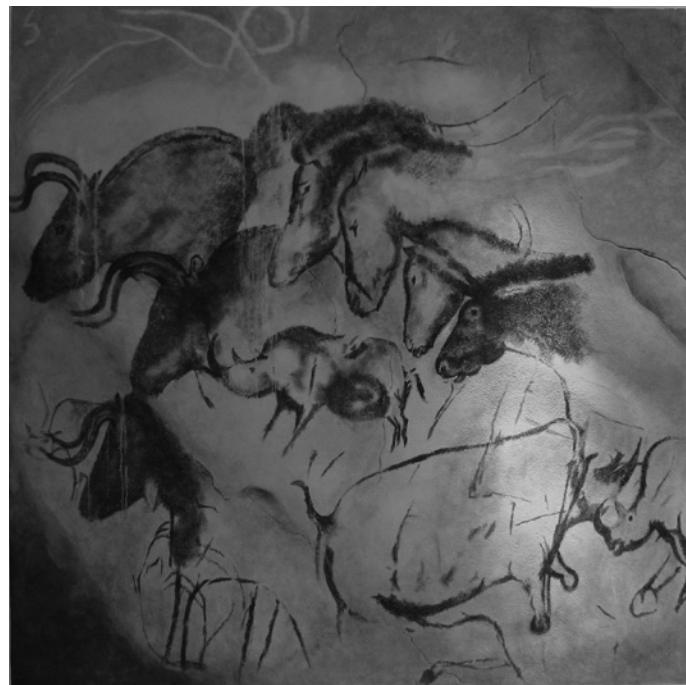
Ancient Civilizations

Art of the Old Stone Age

Although older cave paintings have been discovered elsewhere, the oldest works of art that we will consider are the cave paintings found in Chauvet Cave in southeastern France. These paintings, discovered in 1994, date from c. 30,000 BCE and thus are placed in the Old Stone Age (Upper Paleolithic Period). It should be noted that art historians use the best available information to date works of art from the distant past. Estimated dates are frequently contested and sometimes revised as new information becomes available.

Except for a minimal use of yellow, the paintings and engravings in Chauvet Cave were created using red ochre and black charcoal and depict animals such as horses, rhinoceros, lions, buffalos, and mammoths. Additional cave paintings have been discovered in other parts of France and in Spain, with those in Lascaux and Altamira being the most famous. The art in these caves takes the form of large colored drawings of animals such as horses, bears, lions, bison, and mammoths, and the paintings include several outlines of human hands. The earliest scholarship on these drawings considered them to be the spontaneous scribbling of primitive cavemen. However, with further study, it became apparent that the various groups of drawings had been created by skilled artists working within an established tradition. The artists used pigments of red and yellow ochre to add color to the elegant black outlines they had created using charcoal. Though we cannot be sure of their original function, it is possible that these works were created as a part of hunting ceremonies or other ritual behaviors.

Another well-known group of artworks from the Old Stone Age are small stone female figures that have exaggerated bellies, breasts, and pubic areas. The best known of these figures is the *Venus (or Woman) of Willendorf* (c. 28,000–25,000 BCE), which is about four and one-eighth inches high. In contrast to the exaggerated female features of the body, the facial features of the statue are undefined, the arms are barely visible, and the feet are missing. Scholars contend that these statues were fertility figures although it is not known precisely how they were used.



Painting found in Chauvet Cave.

Art of the Middle Stone Age

During the Middle Stone Age (Mesolithic Period) the climate warmed, and a culture developed that produced art similar in some ways to the cave paintings of the Paleolithic Period. With the warming of temperatures during this era, cave dwellers moved out of their caves and began using rock shelters, as evidenced by the various paintings that have been discovered at such locations in eastern Spain. There has been much scholarly debate regarding the dating of these paintings, but it is generally estimated that they were created from around 7000 BCE until 4000 BCE. The rock shelter paintings, like the cave paintings that preceded them, demonstrate the skill of their creators in the depiction of animal figures. What sets the rock shelter paintings apart from the cave paintings is their depiction of the human figure. Except for one human figure found in the paintings at Lascaux, cave paintings did not include any human beings. The rock shelter paintings, however, portray human beings, both alone and in groups, and there seems to be an emphasis on scenes in which human beings dominate animals.

Art of the New Stone Age

The art forms most often linked with the New Stone Age (Neolithic Period) are rings or rows of rough-hewn stones located in Western Europe. These formations have been dated as early as 4000 BCE. The stones used were often exceedingly large—as much



Photograph of Stonehenge.

Photo by Frédéric Vincent

as seventeen feet in height and fifty tons in weight. Indeed, the sheer size of these works led historians to call the stones megaliths, meaning “great stones,” and the culture that created these works is often termed “megalithic.” The most well known of these rock arrangements is the one found at Stonehenge on Salisbury Plain in Wiltshire, England. Stonehenge is believed to have been built in many phases around 2100 BCE. **Stonehenge** features concentric rings made with sarsen (a form of sandstone) stones and smaller “bluestones”—rocks indigenous to the region. The outermost ring is comprised of huge sarsen stones in post and lintel construction—two upright pieces topped with a crosspiece, or lintel. The next ring is composed of bluestones, which encircle a horseshoe-shaped row of five lintel-topped sarsen stones—these are the largest ones used at Stonehenge, with some weighing as much as fifty tons. Outside the formation, to the northeast, is the vertically placed “heel-stone.” If one stands in the center of the rings and looks outward, this “heel-stone” marks the point at which the sun rises on the midsummer solstice.

The works of art and the ideas we have considered thus far have been isolated examples that have survived a very long time. The works and civilizations that we will consider next point to further conditions that allow for the creation of artworks and enable their survival. Usually, art thrives in highly organized cultures with

stable population centers—usually great cities—that house ruling classes who in turn support the work of artists.

Also, if a civilization has a tradition of protecting its art in locations that are largely inaccessible, it is more likely that the works from that culture will survive to a point where they are included in a study of art history. Many extant artifacts have come from burial chambers, caves, and tombs, where they have been protected by being naturally concealed.

Ancient Mesopotamian Art

The civilizations that arose in Mesopotamia in the valley between the Tigris and Euphrates Rivers developed writing and arts in parallel with Egypt (discussed later). Unfortunately, the Mesopotamian civilizations formed in a valley that lacked the natural barriers of deserts and mountains that protected Egypt. This left them vulnerable to invasion, and hence, the history of this ancient region is one of successive conquest and destruction. Moreover, the use of more perishable materials by Mesopotamian civilizations has left us with fewer examples of their arts.

From around 4000 BCE, the Sumerians in Mesopotamia created impressive sculptures and buildings. Religion was a central aspect of Sumerian life, and the Sumerians built massive temples at the centers of their cities. Less complex platform structures evolved over time



The 4,100-year-old Great Ziggurat of Ur, near Nasiriyah, Iraq.

into the stepped pyramids called **ziggurats**. Around 2334 BCE, the cities of Sumer came under the rule of Sargon of Akkad. Although the Akkadians spoke a different language from the Sumerians, they assimilated Sumerian culture. With the Akkadian dynasty, loyalty to the city-state was supplanted by loyalty to the king, and consequently the art of this period tends to reflect an emphasis on the monarchy, with Akkadian rulers depicted in freestanding and relief sculptures. Around 2150 BCE, Akkadian rule came to an end as the Guti, barbarous mountaineers, invaded and took control. About fifty years later, however, the cities of Sumer were able to reassert control, and a Neo-Sumerian ruler was established as the King of Ur. Perhaps the greatest known works of this era were the ziggurats that were built at the city centers. The ziggurats functioned primarily as temples but also served as administrative and economic centers.

The next important civilization in Mesopotamia was that of the Babylonians. For centuries Mesopotamia had witnessed the coexistence of several independent city-states, but around 1792 BCE, Hammurabi, king of the city-state of Babylonia, was able to centralize power. Hammurabi left an enduring legacy in that he codified Babylonian law—the Code of Hammurabi is the oldest legal code known in its entirety. The best-known artwork from this period, preserved in the Louvre Museum, is related to this code of law; it is a stone stele onto which Hammurabi's code is carved

with a sculpture in high relief at the top that depicts Hammurabi receiving inspiration for his code of law from the sun-god, Shamash.

While the Sumerian, Akkadian, and Babylonian cultures grew in southern Mesopotamia, the Assyrians dominated in the north. From about 900 BCE to around 600 BCE, the Assyrians were the most powerful civilization in the Near East. Among the most notable of Assyrian artworks are relief carvings, which often depict battles, sieges, hunts, and other important events. Throughout the seventh century BCE, the Assyrian hold on power weakened, and from c. 612–538 BCE, Babylonia once again became the dominant force in the region. It was during this Neo-Babylonian period that the famous hanging gardens of Babylon were constructed. Another important construction at this time was the gateway to the great ziggurat of the temple of Bel, called the Ishtar Gate, which is considered one of the greatest works of architecture in which figures—in this case animal figures—are superimposed on a walled surface.

Persian Art

The Persian Empire (c. 538 BCE–330 BCE) flourished in what is present-day Iran. The Persians were notable for their impressive architectural achievements, the most important of which was the palace at Persepolis, which was constructed of stone, brick, and wood and reflects the influence of Egyptian architecture.

Ancient Egyptian Art

Ancient Egyptian civilization is generally dated from c. 3000 BCE, following the predynastic period, through 332 BCE, when Egypt was conquered by Alexander the Great. Recognizable works include the great monuments of ancient Egypt: the Sphinx, the great pyramids at Giza, the larger-than-life-sized statues of the pharaohs, and the portrait head of Queen Nefertiti.

Much Egyptian art emphasizes a style called **hierarchical scale**, which uses the status of figures or objects to determine their relative sizes within an artwork. Hierarchical scale is exemplified in the [Palette of King Narmer](#), a relic from the Old Kingdom. This slab of stone, which may have been used as a ceremonial palette for mixing cosmetics, presents King Narmer centrally, and he is depicted as being considerably larger than the other figures. In the main image on the palette, Narmer is seen holding the hair of a fallen enemy, with his arm raised in preparation for delivering a deathblow. In the lowest section of the palette, below the king and his enemy, are two smaller figures of defeated enemies. The organization of the figures, their relative sizes, and their poses recurred in most of the ancient Egyptian art that followed. Figures are presented so that each part of the body is shown as clearly as possible, in a technique known as “**fractional representation**.” The head is in profile with the eye in frontal view, the torso is in full frontal view, and the lower body, legs, and feet are in profile. This formula became a standard style that endured for centuries as the typical way of representing people in Egyptian art.

We know a great deal about the art of Egypt because excellent conditions for preservation were present in much of Egypt. In addition, the burial customs of the Egyptians, which decreed mummification and entombment with lavish furnishings, symbolic servants, and jewelry, resulted in rich stores of objects and images. The most famous of the Egyptian tombs is that of the boy king, Tutankhamun. By the twentieth century, most of the ancient Egyptian tombs of the Pharaohs had been broken into and robbed of the materials inside. However, Tutankhamun’s tomb, because it was cleverly hidden, remained almost completely intact until 1922. When it was opened, the excavators found a treasure-trove of objects, all superbly made of rich materials. Among the most famous of the objects is Tutankhamun’s burial mask. This mask, found in the innermost layer of the



Burial mask of King Tutankhamun.

king’s sarcophagus, rested on the mummy’s face and shoulders. It is made of gold and is decorated with blue glass and semiprecious stones. The mask presents an idealized portrait of the young king.

Nubian Art

The kingdom of Nubia lay to the south of Egypt and covered a large area of Africa. As contemporary historians become increasingly interested in revising and expanding art history, more knowledge about this great African civilization is being uncovered. Indeed, it is now known that there was a period in the history of Egypt when Nubia ruled the area, and the Pharaohs of that era were Nubian. While there are few collections that feature Nubian works, this may well soon change as revisions to the story of art continue.

Greek and Roman Art

Cycladic, Minoan, and Mycenaean Art

The Aegean island cultures were very important as precursors of the Greeks in terms of art production.

Three major cultures flourished on the islands in the Aegean Sea, on Crete, and along the Aegean coast. The earliest of these cultures, the Cycladic culture, flourished from about 3200 to 2000 BCE in the Cyclades, a group of islands in the Aegean. Archaeologists still have many unanswered questions about Cycladic culture, but the simplified, geometric nude female figures from this area are highly appealing to modern sensibilities. In addition to these sculptures, the Cycladic culture produced decorated pieces of pottery as well as marble bowls and jars. Eventually, the Cycladic culture was supplanted by the Minoan culture, which developed on the island of Crete and reached its pinnacle in the second millennium BCE.

The Minoan culture centered around the city of Knossos on Crete, where the legend of the Minotaur—the creature believed to be half man and half bull who devoured those who entered his maze—is supposed to have taken place. The maze was actually the royal palace, a sprawling complex that has since been excavated. The art of these island people depicts sea life and includes statues of a female snake goddess. The Minoans created artworks that were characterized by a naturalistic pictorial style. Their paintings took two major forms: frescoes painted on palace walls and pottery designs. The architectural achievements of the Minoans were also impressive, as they built four major palaces, all completely unfortified and designed in a light, flexible, and organic style.

The collapse of the Minoan civilization coincided with the pinnacle of Mycenaean culture, and as a result, many historians believe the Minoans were destroyed by the Mycenaeans. The Mycenaean culture was centered around the city of Mycenae on the Greek mainland. The Mycenaeans built elaborate tombs, and their burial practices allowed for a large number of objects to be preserved. The objects that are best known are made of gold and show astonishing levels of mastery in goldsmithing. Additionally, the Mycenaeans demonstrated much skill in their use of **relief sculpture**.

Ancient Greek Art

From around 660 to 475 BCE, during the Archaic Period, the Greeks, influenced by the stone sculptures of Egypt and Mesopotamia, created sculptures carved in marble and limestone. These freestanding figures borrowed the frontal pose used in Egyptian art, but were more dynamic and placed greater emphasis on depicting

realistic human features. Temples were also built during this time period using columns in the early **Doric** and **Ionic** decorative styles. Vase painting was another notable art form and was done in many different styles. Some vases portrayed black silhouetted figures, while those in the **Corinthian** style set figures against a floral, ornamented background. Athenian-style vases used black figures, but were more linear and larger in scale. Red-figure vases, with red figures standing out against a black background, were also common.

The best-known ancient Greek art is that from the city-state of Athens from the Classical Period. During the Early Classical Period, temples were typically built with sturdy, Doric columns. Unfortunately, much of the sculpture from this period has not survived, but luckily Roman copies have provided us with a good deal of information on these ancient works. The sculpture of the Early Classical Period was characterized by its solemnity, strength, and simplicity of form and most often focused on a figure or scene either in the moment before or the moment after an important action. Significant advances were made in sculptural techniques, as the stiff frontal postures of the Archaic Period were largely abandoned in favor of more complex and life-like figures and positions.

Greek statuary evolved from a stiff, frontal presentation like that of the Egyptians to an increasingly natural-looking figure. A pose called “**contrapposto**,” or counter positioning, was invented to show the body to its best advantage. In contrapposto, the standing figure is posed with its weight shifted onto one leg, for a more relaxed, naturalistic appearance. Greek sculpture set the model for thousands of years in Western art, and the Renaissance, Baroque, and Neoclassical artists of the fifteenth through early nineteenth centuries aspired to equal the perfection displayed by the surviving Greek statues.

The Middle Classical Period witnessed important advances in architecture as is evident in the temples of this time period. The temple called the **Parthenon**, restored in 447 BCE after being destroyed by the Persians in 480 BCE, is one of the most admired works of all ages, and the use of columns as exemplified in the Parthenon has been a principal feature of Western architecture for more than two thousand years.

Architecture declined during the Late Classical Period as Athens was defeated in the Peloponnesian War.

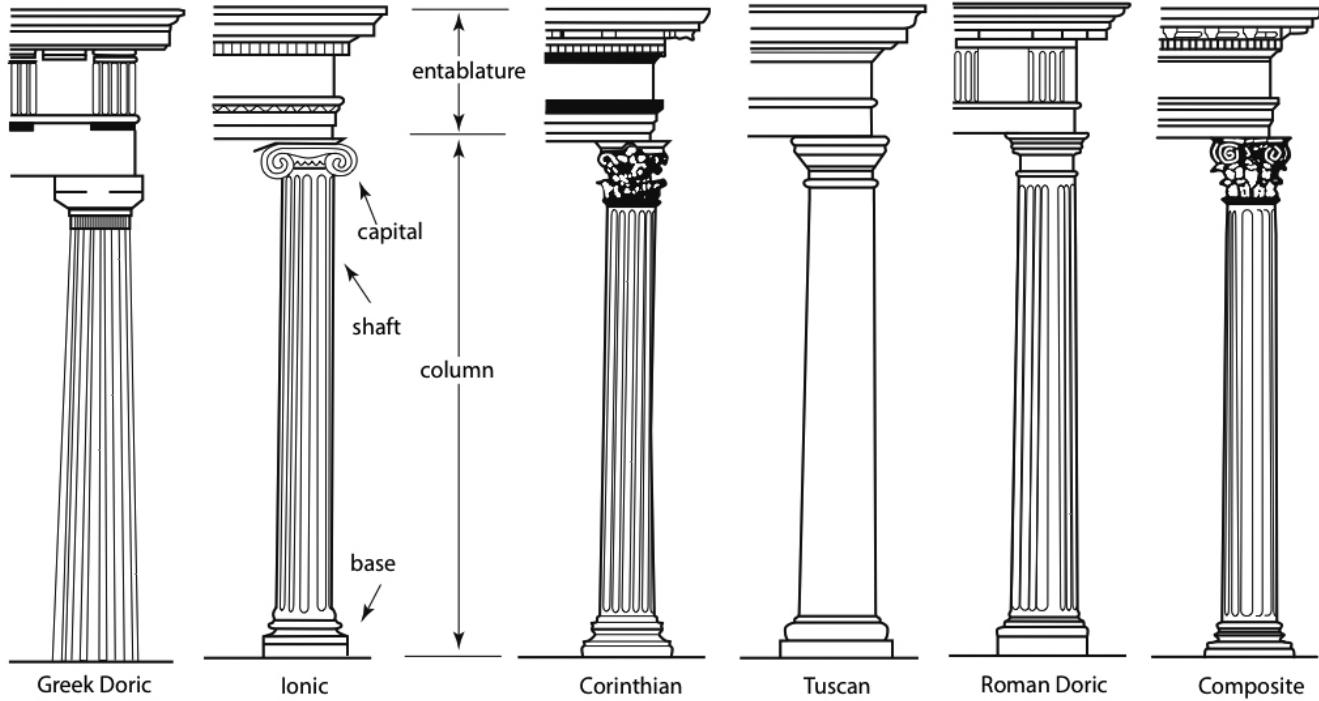


Diagram of Greek and Roman Orders. Classical Greek and Roman columns consist of a base, shaft, capital, and an entablature. Doric, Ionic, and Corinthian orders are differentiated by their degree of ornamentation.

Temples in this era were still built using simple Doric columns, but the use of highly decorative Corinthian columns became more and more popular. The Hellenistic Period saw an increasing influence from Eastern civilizations as Greek styles blended with those of Asia Minor. Notable works of this time period include freestanding sculptures such as the [Venus de Milo](#) and the [Laocoön Group](#), which are masterworks designed to present ideals of beauty.

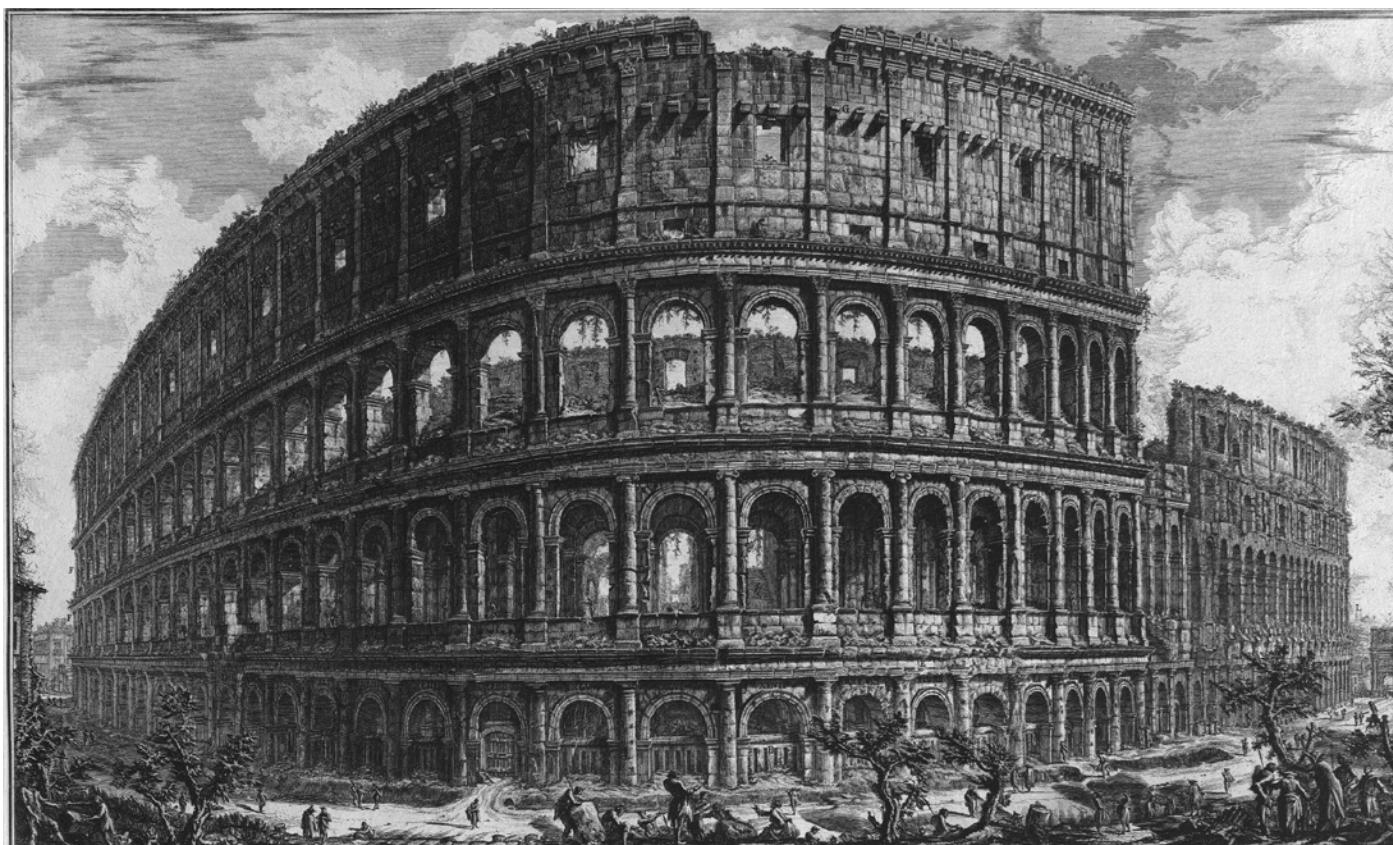
Etruscan Art

The art of the Etruscan civilization is seen as a transition from the ideals of Greece to the pragmatic concerns of the Romans. Etruscan civilization arose in what is now Italy in the first millennium BCE. Like other cultures we have examined, this one is known largely from the arts of tomb decoration. Nothing remains of Etruscan buildings as these were constructed of brick and wood. However, ceramic models depict temples with tiled, gabled roofs supported by columns in the fashion of the Greeks. Extant Etruscan artifacts also include sarcophagi lids and other art forms made of baked clay, as well as objects that display the Etruscans' talent in bronze work. The only paintings that remain from the Etruscan culture are those found on the walls

and ceilings of tombs. These were done in bright, flat colors, and they show figures playing music and dancing as part of funeral celebrations.

Roman Art

The story of Rome is one of conquest and empire building. Early Roman art reflected the influence of Etruscan art. However, by the second century BCE many Roman sculptures and other Roman artworks were variations of Greek works, and the standards for idealized presentations of Roman rulers were based on those of the Greeks. The Romans, however, made pioneering advancements in architecture and engineering. The Roman discovery of the equivalent of modern **concrete** was a major contribution to architecture, as it enabled Roman builders to fill the spaces between their stone walls with rocks and rubble bound together by the concrete mixture. With this strong material, the Romans were able to construct huge domed buildings. They also pioneered the use of the curved **arch**, using this form to build bridges and aqueducts. These structures were part of a paved road system, making communication and control very effective in the Empire. Two buildings that can still be seen in Rome, the [Colosseum](#) (72–80 CE) and the [Pantheon](#) (c. 126–128 CE), remain as monuments to the



The Colosseum as depicted in a 1757 engraving by Giovanni Battista Piranesi.

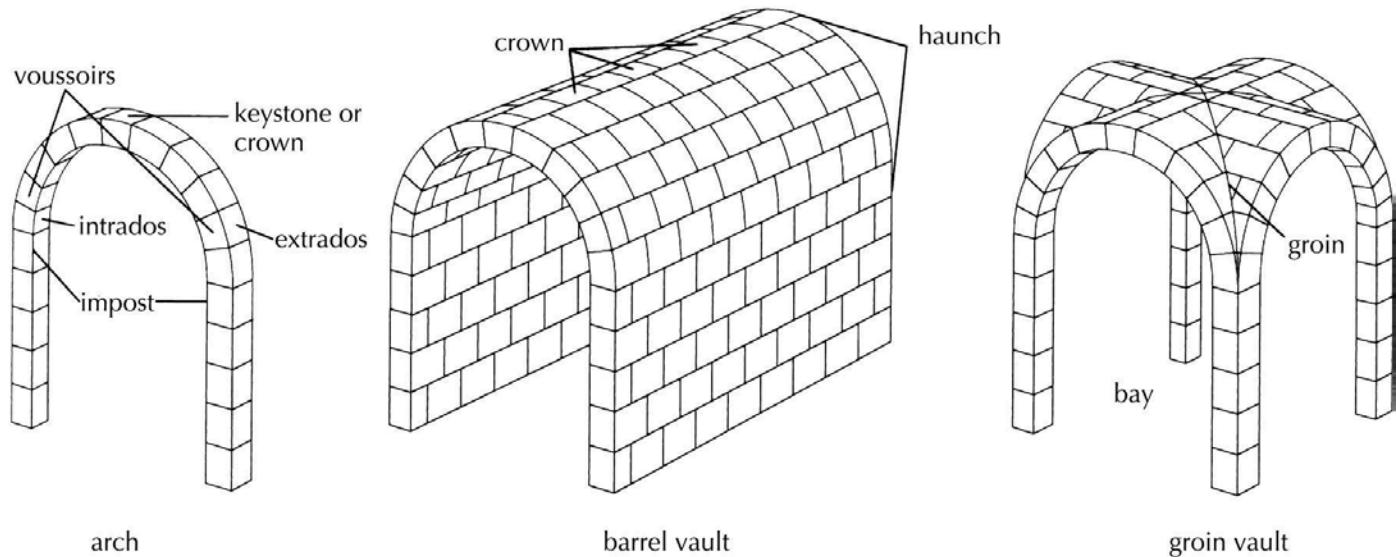
engineering genius of the Romans.

The Romans created numerous sculptures. Often, colossal triumphal arches would be topped with relief sculptures portraying Roman emperors or Roman military victories. The Romans also created relief sculptures for funerary purposes. Tombs and sarcophagi were decorated with reliefs. Some of these reliefs were simply decorative, but many others had narrative subject matter. The Romans also sculpted portraits, which ranged in size from tiny busts to huge statues. During the Roman Republic it became common for members of a funeral procession to carry small carved images of the deceased family member. Later, statues in memory of great statesmen or other noble figures were erected in public areas. Both the funerary sculptures and the public statues did not present naturalistic depictions of their subjects. Rather, the Romans favored an idealistic style that highlighted Roman ideals. The art of the Romans not only had a tremendous influence on the art of the Middle Ages, but also had a notable impact on the art of the Renaissance and much of the art that followed.

Byzantine and Medieval Art

With the fall of the Roman Empire, the connections between its parts disintegrated, and what was once a vast empire evolved into separate and often warring kingdoms. But even as the Empire collapsed in Western Europe, it continued in Byzantium. The art that is best known from this Eastern culture is **mosaic** work in which small ceramic tiles, pieces of stone, or glass were set into a ground material to create large murals. It is an art that is largely Christian in content and can best be studied in the glimmering, shining mosaic walls of the great churches of Ravenna. Although Ravenna is in present-day Italy, it was then under Byzantine control. In terms of Byzantine architecture, the [**Hagia Sophia**](#) (532–537 CE), built in Constantinople, is still considered one of the greatest architectural achievements in history.

The medieval period witnessed a great deal of civil strife, and consequently the art of this era was preserved largely by the Church. During these times, the majority of the population was illiterate; formal education was largely limited to the noble class and the clergy. The



Components of an arch, a barrel vault, and a groin vault. The Romans pioneered the use of the curved arch.

international language was Latin, and books were hand copied on vellum or parchment. The preservation and production of books was largely confined to monasteries, where the monks spent time copying and illustrating the books in their collections, which were so valuable that they were chained to the tables where they were read. These illuminated manuscripts were remarkable works of art and helped facilitate the exchange of artistic ideas between northern and southern Europe. Among the many notable examples are the [Book of Kells](#) (late eighth or early ninth century) and the [Coronation Gospels](#) (c. 800–810).

Notable from the early medieval period (c. 375–1025) is the art of nomadic Germanic peoples, particularly their metalwork. The metal arts of this time period were abstract, decorative, and geometric and often took the form of small-scale, portable jewelry or ornaments made of bronze, silver, or gold and covered with patterns of jewels. Artifacts from this era also exist from the seafaring culture of the Vikings in Scandinavia. While metalwork was popular with the Germanic peoples, wood was the most important medium to the Vikings, who carved artistic designs and sculptures on their wooden ships. As a result of Viking invasions, the artistic styles of the Vikings eventually merged with those found in Anglo-Saxon England and Celtic Ireland. The resultant style is often termed Hiberno-Saxon.

In later medieval art, the architecture of churches

became a dominant art form. Every city, town, and village had a church at its center, and the largest of these are masterpieces of art that often took more than a century to complete. The earliest churches of this period used a Roman arch as the basis of their design, and so the style used is called Romanesque. One famous example is [Saint-Sernin](#) in Toulouse, France (c. 1070–1120). Romanesque churches were stone vaulted buildings that often replaced earlier churches that had highly flammable wooden roofs. Romanesque churches are usually formed of a tunnel of arches called a **barrel vault**. A **vault** is an arch-shaped structure that is used as a ceiling or as a support to a roof. Massive walls had to be built to support the heavy stone arches of the Romanesque style. Consequently, window and door openings were usually kept quite small and were often decorated with carvings and relief sculpture.

The Gothic style developed in the first half of the twelfth century and remained popular into the sixteenth century. Though this style was used for some secular buildings, it was largely applied to the construction of churches. One characteristic of the Gothic style was the use of pointed arches, which gave an upward, soaring sense to Gothic interiors. Another important element of the Gothic style was the addition of **ribbed vaults**, a framework of thin stone ribs or arches built under the intersection of the vaulted sections of the ceiling. A key innovation came in the early Gothic period when architects learned that the downward and outward pressure created by the arches of the barrel vault could

be counteracted by the use of **flying buttresses**—additional bracing material and arches placed on the exterior of the building. This advance allowed for larger windows, many of which were filled with beautiful stained glass, and higher ceilings. A classic example of a Gothic cathedral is [Chartres Cathedral](#) in France (begun c. 1145; rebuilt after 1194). Here the effect of the tall arches and the brightly colored light from the stained-glass windows directs attention heavenward.

The Renaissance in Southern Europe

Although we often tend to divide historical periods into a series of discrete and separate styles and events, in actuality, history is much more complicated and subtle. The transition from the later medieval period to the Renaissance provides a good example of this, as the styles from this period cannot be neatly identified as either Gothic or Renaissance, but rather involve a mix of the two. The artist most often mentioned in connection with this transitional time period is a Florentine named Giotto di Bondone (1267–1336/37), who is best known for his frescoes. A key advance visible in Giotto's works is his use of a simple perspective, achieved in large part by overlapping and modeling his figures in the round. This technique created the illusion of a stage for his figures, giving the viewer a sense of looking into the event. Giotto's works were different from many Gothic works as he gave his figures powerful gestures and emotional expressions. To our eyes, his paintings may not look entirely naturalistic, but his artistic innovations must have had quite an impact on viewers at the time, who were accustomed to the flat, unexpressive, and stylized figures of the Gothic style.

Like the art of ancient Greece, the art of the Renaissance continues to have an impact on art today. It is interesting to note that a change in the economy played a key part in triggering the Renaissance. It was in this time period that paper money was first developed, and its use led, in part, to the vast fortunes accumulated by notables such as the Medici family. These wealthy families were the major patrons of the arts during the Renaissance era. Another important factor was the fact that examples of Greek and Roman art were readily available in Italy, and these classical works of art had a tremendous impact on the art of the Renaissance.

As we discuss the art of this period and later, you will observe that the lives and works of individual artists are often highlighted, while this has not been the case in our discussion of earlier periods. In part, this can



View of the dome of Florence Cathedral.

be attributed to a new emphasis on the individual and the concept of individual genius that emerged during the Renaissance. Until the time of the Renaissance, painters and sculptors were, in accordance with Greek traditions of art, considered artisans. That is, they were people who were viewed as being of lesser status because they worked with their hands. During the Renaissance, the role of artists in society changed, as great artists came to be recognized as intellectual figures. Consequently, artists were accorded a special place in society.

An important event near the beginning of the Renaissance was a competition held in the city of Florence in 1401 for the design of the doors for the city's new baptistry. The winner of that competition was Lorenzo Ghiberti (1381?–1455), who designed a door panel that had figures harkening back to those of classical Greece. Ghiberti's panel design depicts the sacrifice of Isaac, in which Isaac appears as a classical



Leonardo da Vinci's Mona Lisa.

Greek figure. Soon after the doors were installed, Ghiberti was asked to make a second set for another entrance to the cathedral. This second set took more than twenty-five years to complete. The doors were so magnificent that Michelangelo called them the “[Gates of Paradise](#),” and they have been referred to by that name ever since.

The second-place winner in the competition was Filippo Brunelleschi (1377–1446). After losing the competition, he concentrated on architecture and won a competition to complete the dome of the cathedral in Florence, which had remained unfinished for many years because architects had not been able to construct the huge vault that was required to span the open space. Brunelleschi achieved this major engineering feat with the help of a double-shelled dome design that has been imitated by many later architects. Brunelleschi is also credited with developing **linear (single vanishing point) perspective**. Masaccio

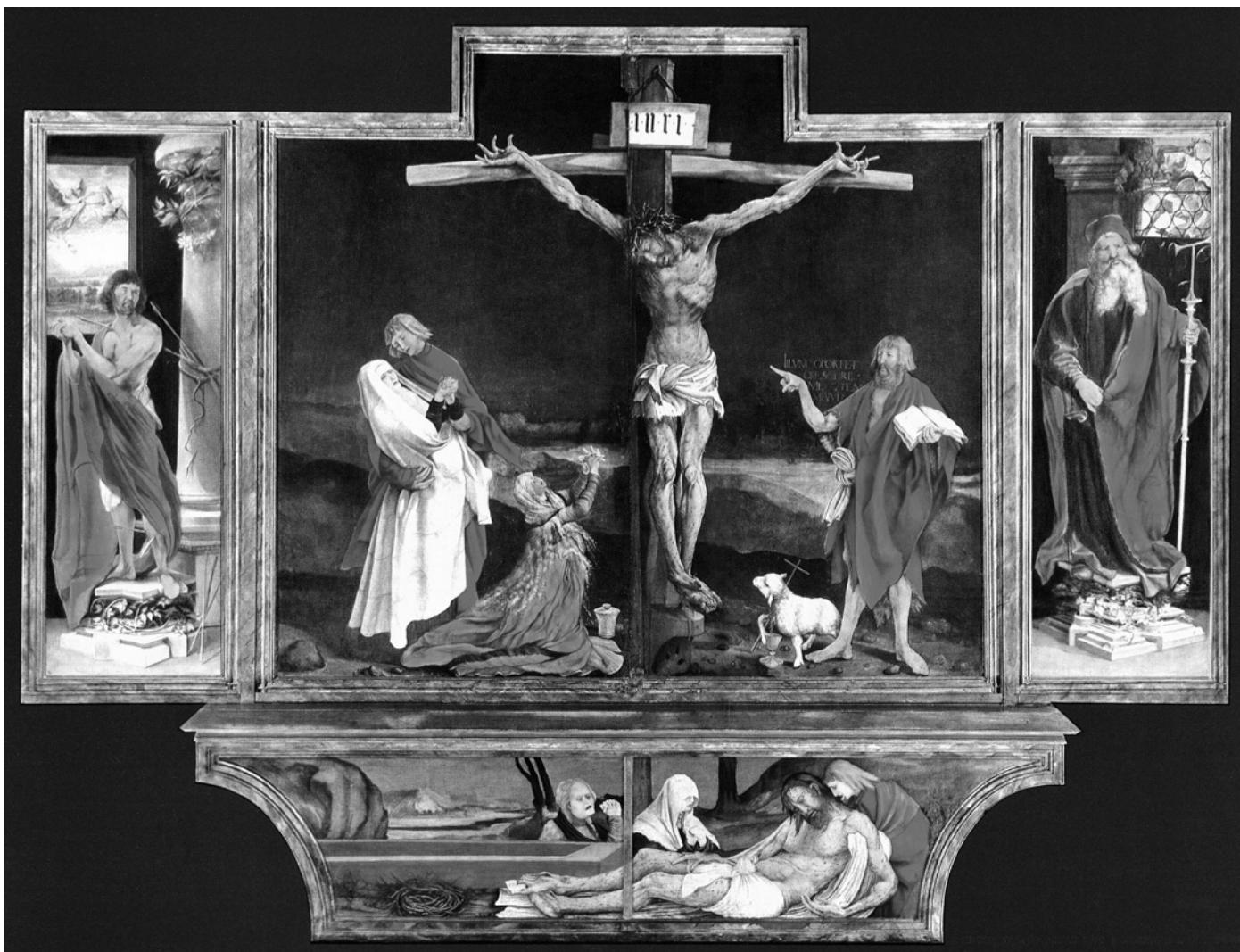
(1401–28), a Renaissance painter, is given credit for putting Brunelleschi’s theory into practice, as he used both linear and **aerial perspective** in his frescoes. The development of linear perspective had a tremendous and lasting influence on the world of art.

Among the most remarkable of Renaissance artists was Donatello (1389?–1466), who is widely considered the founder of modern sculpture. The influence of classical antiquity on his sculpture was strong, as evidenced by his best-known work, a bronze statue of [David](#) (c. 1420s–60s). This work was the first known freestanding nude statue to have been cast since antiquity. Toward the end of his life, Donatello’s sculptures reflected a greater emphasis on naturalism and the expression of character and dramatic action.

A generation later, the work of Botticelli (1444?–1510), particularly his best-known painting, [The Birth of Venus](#) (c. 1482), established an image of female beauty that has lasted through the centuries. His long-necked Venus with her languid pose and flowing hair was one of the first paintings of a full-length nude female since antiquity.

The generation of artists that followed are often referred to as High Renaissance artists. Two well-known artists of this time period, Leonardo da Vinci (1452–1519) and Michelangelo (1475–1564), are the models for the term “Renaissance Man.” Leonardo da Vinci is well known as an inventor, but also is recognized as an architect, engineer, painter, sculptor, scientist, and musician. His design for the locks that control movements along canals from one level to another is still used today, and his drawings of submarines and helicopters have been found to be viable models. Two of his paintings, [The Last Supper](#) (c. 1495–98) and the [Mona Lisa](#) (c.1503–05), have become so well known that they are now icons of popular culture. Leonardo’s key innovation in painting, which is readily apparent in the *Mona Lisa*, is the use of **sfumato**. Sfumato, from the Italian word *fumo*, meaning smoke, is the use of mellowed colors and a blurred outline. Sfumato allows forms to blend subtly into one another without perceptible transitions.

At the same time that Leonardo was working in Florence, another artist, Michelangelo di Buonarrotti, was at work on the piece that would establish his reputation as a sculptor. The city held a competition to have a statue created from a massive piece of marble



A partial view of Matthias Grünewald's Innsbruck Altarpiece.

that it had acquired, only to discover that the marble was flawed. Taking this difficult piece, which had a large crack in the middle, Michelangelo turned it into his vision of [David](#) (1504). The statue is larger than life-sized, as it was originally meant to be placed high on the façade of the cathedral in Florence and would have been viewed from far below. The beautiful carving, the smooth texture of the finished marble, and the striking pose were seen as the very embodiment of the spirit of Florence as a republic.

Throughout his stormy career, Michelangelo created a large number of other important sculptures, but it is a painting that often comes to mind when people hear his name. In 1505, Pope Julius II commissioned Michelangelo to design his tomb. Michelangelo began sculpting great statues such as [Moses](#) (c. 1513–15), [The Dying Slave](#) (1513–16), and [The Bound Slave](#) (1513–16) to be included in the Pope's colossal tomb. However,

in the midst of this commission, the Pope canceled the project for uncertain reasons. The cancellation of his work on the Pope's tomb was one of the greatest disappointments of Michelangelo's career, and he was bitter and hesitant when Pope Julius II gave him another commission. This time, the artist was asked to decorate the ceiling of the Sistine Chapel. It took Michelangelo four years, from 1508 to 1512, to cover the seven hundred square yards of the ceiling, but the result was an astonishing tour de force. The great masterpiece of the Sistine Ceiling has received renewed attention in recent decades, as restorers set about cleaning the great frescoes. The cleaning removed the collection of oil, wax, and grime that had accumulated over the centuries, and the colors have returned to their original brightness. Not everyone was happy with the results of the cleaning, however, and a controversy about this restoration, as well as the restoration of artworks in general, continues

within the art world.

One of the most influential painters of the High Renaissance was Raphael Sanzio (1483–1520). When he was a young painter, Raphael was brought to Rome, where Julius II gave him several commissions. During this period, Raphael learned much from Michelangelo, his older rival. Unlike Michelangelo, Raphael was not a loner, but employed numerous assistants to help him cover the Pope's official chambers with large, sumptuous frescoes, notably the *School of Athens* (c. 1508–11), an homage to the great Greek philosophers and scientists. Raphael is considered the most influential painter of the Madonna. His masterworks, such as the *Sistine Madonna* (c. 1513–14), created an image of the Virgin Mary that has endured in religious paintings throughout the centuries.

Rome and Florence were not the only locations to witness an incredible flowering in the arts. Venice, too, became a center of artistic creativity. Giorgione (1477/78–1510) is credited with making innovations in the subject matter of landscapes, as he painted scenes not taken from the Bible or from classical or allegorical stories. Prior to Giorgione's painting *The Tempest* (c. 1508), artists had generally begun with the figures that were to be the subject matter of the painting and then added the background. However, in *The Tempest* the landscape became the subject of the painting—the figures depicted are of lesser importance than the storm that threatens them.

Titian Vecelli (c. 1488–1576) was one of the most prolific of the Venetian painters. Titian is well known for his portraits of his patrons, and he is also recognized as having been the greatest colorist of the Renaissance artists. Titian was an innovative portraitist. He used various elements of setting, such as a column or a curtain, as the backdrop for his portraits instead of an atmospheric neutral background, as had been the custom. The influence of Titian's use and arrangement of background elements can be seen in portraiture up through the twenty-first century.

Tintoretto (1518–94), another great Venetian painter, is often linked with an artistic style called **Mannerism** that grew in popularity in the late sixteenth century. Mannerist works are characterized by the distortion of certain elements such as perspective or scale and are also recognizable by their use of acidic colors and the twisted positioning of their subjects. Although

Tintoretto used some Mannerist pictorial techniques, his color schemes differed from those of the Mannerists. Tintoretto presented his figures from dramatic angles—it is said that he used small figures as models and arranged them and rearranged them until he had the most dramatic effect. He also used dramatic contrasts of light and dark, called **chiaroscuro**, to heighten the emotional impact of his subjects. Tintoretto's later works are marked by their spiritual subject matter, and his use of sharp perspectives and chiaroscuro anticipate the Baroque era.

One of the most important events impacting the history of sixteenth-century art was the **Reformation**. Protestants criticized the opulence and corruption of the Catholic Church and called for its purification. For art, this meant a move away from the richly decorated churches and religious imagery of the Renaissance. The Church reacted to the Protestant Reformation by launching a **Counter-Reformation**, which emphasized, even more than before, lavish church decoration and art of a highly dramatic and emotional nature. One of the artists most closely associated with the Counter-Reformation is Dominikos Theotokopoulos, known as El Greco. El Greco was strongly influenced by Tintoretto's paintings, and he worked for a period of time in Titian's workshop in Venice. In 1576, El Greco left Italy for Toledo, Spain. El Greco is one of the most well known of the Mannerist painters, and his dramatic use of elongated figures captured the religious fervor of the Counter-Reformation. The works of both El Greco and Tintoretto can be seen as transitional works bridging the end of the Renaissance and the beginning of the Baroque period.

The Renaissance in Northern Europe

During the fifteenth century, the artworks being produced in northern Europe were smaller in scale than those of contemporaneous artists to the south. However, the work of northern artists displayed a degree of realistic detail beyond what can be seen in works of the south, primarily due to their use of new **oil paints**. While the Renaissance was occurring in Italy, much of European art north of the Alps was still Gothic in style. The influence of classical antiquity was also much less of a factor in the north, as the northerners did not share Italy's cultural connection with ancient Rome, nor did they have the advantage of being in close proximity to ancient Roman works as did their Italian counterparts.

The art of northern Europe in the sixteenth century demonstrates a far greater awareness of the Italian Renaissance than that of the fifteenth century. Many artists traveled to Italy to study the great works of the Renaissance, and some Italian artists brought these ideas with them when they traveled to the north. Engravers copied some of the more notable Italian works, and these engravings became available throughout Europe, thus spreading the ideas and styles of the Renaissance. Trade connections between upper-class German merchants and merchants in Venice, a center of trade and art, provided another avenue of influence.

Though the influence of the Italian masters was notable, not all northern artists embraced the ideals and innovative techniques of the Renaissance, as many maintained a more traditional approach. Moreover, though linear perspective and the colors used farther south did travel northward, the manner in which they were used in the northern countries was quite different.

During the fifteenth century and into the early decades of the sixteenth century, areas of southern Germany witnessed a flowering of artistic production. Matthias Grünewald (1475?–1528) and Albrecht Dürer (1471–1528) are often considered the greatest artists of the Renaissance in northern Europe. Although only ten of Grünewald's works have survived, his influence has nonetheless been notable. Grünewald is known for his religious scenes and his depiction of Christ's crucifixion. The [Isenheim Altarpiece](#) (c. 1510–15), a work consisting of nine panels mounted on two sets of folding wings, is considered to be his greatest masterpiece.

Albrecht Dürer is perhaps the most famous artist of Reformation Germany. Dürer's early training was largely influenced by late Gothic works, but as the ideas of the Italian Renaissance spread northward in the sixteenth century, Dürer's work began to reflect some of these new influences. Dürer aimed to achieve a style that combined the naturalistic detail favored by artists of the north with the theoretical ideas developed by Italian artists. He traveled to Italy, studied the work of his Italian contemporaries, and brought his new knowledge back to Germany. Dürer wrote about theories of art and published many series of woodcuts and copper engravings, such as [The Four Horsemen of the Apocalypse](#) (c. 1498).

Hans Holbein the Younger (1497–1543) is another important artist of this era, and he is considered one

of the greatest Renaissance portraitists. Though born in Germany, Holbein is best known for his work in England. He became court painter to King Henry VIII of England, and his portrait of Henry VIII shows not only his talent for presenting details, but also his ability to capture the psychological character of his subjects. Holbein's works became the model and standard for English painting up through the nineteenth century.

Baroque Art

The term “**Baroque**” is generally used to refer to artworks produced from the late sixteenth century through the mid-eighteenth century. Baroque styles differed from those of the Renaissance in that Baroque artworks tended to be less static than Renaissance examples; the Baroque is characterized by a greater sense of movement and energy. The political structure of Europe during the Baroque era also differed from that of the Renaissance. Whereas the Renaissance witnessed wars between cities, the Baroque era saw conflicts between empires. During this time, the Church was determined to preserve its dominance in Spain and Italy, and orders like the Jesuits were founded to convert the peoples of other areas. Baroque art appealed largely to the emotions, and thus, these artists, influenced by the Counter-Reformation, aimed at dramatic and moving appeals to faith.

The seventeenth and eighteenth centuries in Europe were a time when society was governed by a ruling class that viewed its power as a divine right. Some of the most powerful sovereigns ever to rule are from this period. Empress Maria Theresa of Austria, Peter the Great and Catherine the Great of Russia, and King Louis XIV of France dominated the lives of the people of their countries. It was a time that saw the ongoing concentration of power and wealth into the hands of a few, until the results eventually became intolerable for the majority of the people. While a small minority of the population lived in great luxury, the lives of ordinary people were generally quite difficult, and eventually this disparity gave rise to protests like those found in the writings of Enlightenment authors, Jean-Jacques Rousseau in particular. Ironically, however, it was the patronage of the wealthy ruling class that gave rise to the great works of art of the period.

As we might expect, the art of the Baroque period moved away from the classic simplicity and calm that was so characteristic of Renaissance works. The word



Rembrandt's The Company of Frans Banning Cocq and Willem van Ruytenburch, known as The Night Watch.

"baroque" has come to represent the richness of color and ornamentation that heightened the energy and emotion that were characteristic of the great works of art of this period. The emphasis was on dynamic works that presented imagery in the most dramatic way possible.

Baroque painters made use of chiaroscuro, using exaggerated contrasts between light and dark to create a theatrical kind of lighting that made the subject appear to be in a spotlight. Caravaggio (1571–1610), an Italian Baroque painter, was renowned for his dramatic use of light and dark, and his technique influenced many artists who followed. Caravaggio's work is so important that artworks using extremes of dark and light are often termed "caravaggesque." Caravaggio's work is also notable for its provocative degree of naturalism. For

example, Caravaggio portrayed the Virgin Mary and the apostles not as noble figures in classical garb as they had traditionally been represented, but instead depicted them as poor and simple folks in threadbare garments. His use of actual lower-class individuals as models for his work helped him achieve this effect. It is no wonder that several patrons of Caravaggio's canvases rejected them for this reason.

With recent revisions of art history, a woman named Artemisia Gentileschi (1593?–1652?) has also joined the ranks of important Baroque artists. Gentileschi, the daughter of a painter, had the unusual opportunity to study in her father's studio. She is particularly known for her remarkable adaptation of Caravaggio's techniques. Her works include self-portraits and

paintings of Old Testament women.

The most important Baroque artist, Gianlorenzo Bernini (1598–1680), the son of a sculptor, was a child prodigy who received recognition from the Pope at age seventeen. Bernini did his most significant work in sculpture, but he was also a talented architect, painter, and draftsman. He worked as a designer in the theater, and many of his works reflect the influence of his theatrical background. His most important masterpiece, the *Ecstasy of Saint Teresa* (1647–52), is set into the altar of the Cornaro Chapel. The space includes a concealed stained-glass window that bathes the figure of the saint in dramatic gold lighting, as if she were on a stage. Bernini treated his medium in a new way as well. He did not adhere to the classical calm and natural flow of drapery around the figure that had been used in the past. Instead, Bernini pushed the use of marble to new limits and tried to make stone look like real fabric and even clouds.

The importance of the Baroque style extended beyond Italy. In Flanders, Peter Paul Rubens (1577–1640) established a huge workshop and produced works of great energy and color that became models for many artists. In the mid-seventeenth century, Rembrandt van Rijn (1606–69), a Dutch artist, created some of the best-known works from the Baroque period. Rembrandt is recognized not only as a painter and printmaker, but also as one of the greatest draftsmen ever. Perhaps his best-known work is *The Night Watch* (1642), more properly known as *Sortie of Captain Banning Cocq's Company of the Civic Guard*. Like many other group portraits of the time, each member of the company depicted paid a certain sum to be included in the painting. Rembrandt chose to break with tradition and grouped the members of the company in a way that gave more attention to some members than to others. This break with tradition, as well as other problems in his life, ultimately caused the decline of his career. Though Rembrandt died in poverty, the self-portraits of his later years are considered to be some of the greatest studies of the inner life of the sitter ever to be painted.

It might be argued that the Baroque period reached its peak in France. There, Louis XIV had come to power, and his long reign was marked by a blossoming of French culture. Louis XIV united all of France and built a lavish *palace* at Versailles beginning in 1669. The palace and its grounds covered about two

thousand acres and included various grand chateaux and gardens. There was a stable, capable of housing hundreds of horses, and a grand *orangerie*, or greenhouse, for the king's orange trees. Eventually there was also a zoo and a system of fountains and waterfalls that included a grand canal large enough for the staging of mock sea battles. The opulence and power of this “sun king,” around whom the world of the court revolved, became a model that contemporaneous monarchs tried to emulate.

An important feature of Louis XIV’s court that was to influence art well into the nineteenth century was the system of choosing and supporting artists called the *Salon*. This annual exhibition established a set of rules for judging art that is still influential in the art world today. It was also under the rule of Louis XIV that the *Académie Royale de Peinture et de Sculpture*, often referred to simply as the “**Academy**,” was established, and it soon came to be a means for imposing aesthetic standards and principles of taste.

To the south, the Spanish court of King Philip IV of Spain tried to emulate the court of France, and his court painter, Diego Velázquez (1599–1660), was a contemporary of Bernini. Velázquez’s method of building his figures from patches of color, rather than starting from a drawing, became a model for many later artists. In fact, Velázquez’s work had an influence on the movement we call Impressionism.

Rococo, Neoclassicism, and Romanticism

While the **Rococo** style might be seen as an extension of the Baroque period, it is quite different in form and content. Whereas the Baroque aimed to arouse grand emotions, Rococo works were celebrations of gaiety, romance, and the frivolity of the grand life at court, particularly the court at Versailles. The emphasis was on light-hearted decoration with the use of gold and pastel colors.

Three artists who excelled at capturing the elegance and wit so valued by their aristocratic patrons are considered the greatest masters of the Rococo style. Jean-Antoine Watteau (1684–1721) was the leader of a new generation and the innovator of a new genre of painting called the *fête galante*. Paintings of this genre generally depicted members of the nobility in elegant contemporary dress enjoying leisure time



Jacques Louis David's *Oath of the Horatii* (1784).

in the countryside. François Boucher (1703–70) was influenced by Watteau's delicate style. He became the favorite painter of Madame Pompadour, mistress to Louis XV, and his works often transformed the characters of classical myth into scenes of courtly gallantry, with an emphasis on nubile nudes. Jean-Honoré Fragonard (1732–1806) was also promoted by Madame Pompadour. Fragonard studied with Boucher, and his works strongly reflect Boucher's influence.

The Revolution of 1789 in France ushered in an era of great change throughout Europe, and the idea of a democratic republic ruled by and for the people was reflected in the artwork of the time. In an attempt to hearken back to the democratic ideals of the ancient world, art of this period demonstrated a revival of interest in the art of classical Greece and Rome. This style, called **Neoclassicism**, emerged in the decades

leading up to the Revolution and was also influenced by Enlightenment philosophy. The Neoclassical style, a direct challenge to the Rococo and its associations with the aristocracy, is epitomized in the work of Jacques Louis David (1748–1825), whose paintings, such as the *Oath of the Horatii* (1784), illustrated republican virtues. Following the Revolution, David joined members of the new government as the master of ceremonies for the grand revolutionary mass rallies. Later he became a dedicated painter to Napoleon Bonaparte, and in this capacity he painted large propagandistic canvases that would seem to undermine his earlier revolutionary ideals. A closer investigation of his work and his career reveals the complicated world of an artist and his patrons. The work of David's pupil, Jean Dominique Ingres (1780–1867), shows the sharp outlines, unemotional figures, careful geometric composition, and rational order that are hallmarks of



Gustave Courbet's *The Stonebreakers*.

the Neoclassical style.

Ingres's rival, Eugène Delacroix (1798–1863), was a proponent of **Romanticism**. This style hearkened back to the emotional emphasis of the Baroque and had similar characteristics, though the subject matter was different. Whereas Neoclassical works emphasized line, order, and a cool detachment, Romantic painting tended to be highly imaginative and was characterized by an emotional and dreamlike quality—the Romantics favored feeling over reason. Romantic works are also characterized by their incorporation of exotic or melodramatic elements and often took awe-inspiring natural wonders as their subject matter. Delacroix's works are characteristic of the Romantic movement in that they centered on exotic themes and included foreign settings, violence involving animals, and historical subject matter. Théodore Gericault (1791–1824) and William Blake (1757–1827) were also important Romantic artists.

Realism and Impressionism

In many ways, **Realism** was a reaction to Neoclassicism and Romanticism. The Realist style

was inspired by the idea that painting must illustrate all the features of its subjects, including the negative ones. It was also obligated to show the lives of ordinary people as subjects that were as important as the historical and religious themes that dominated the art exhibitions of the day. The artist who represented this movement most forcefully was Gustave Courbet (1819–77), a flamboyant and outgoing personality who outraged conventional audiences by showing a painting of ordinary workmen repairing a road at the official government-sponsored Salon. This work, called *The Stonebreakers* (1849–50), also had political implications in the context of a wave of revolutions that spread across Europe beginning in 1848. Realism can also be seen in the works of Honoré Daumier (1808–79) and Jean François Millet (1814–75).

Impressionism largely grew out of dissatisfaction with the rigid rules that had come to dominate the *Salons* held to recognize selected artists each year. Édouard Manet (1832–83) is sometimes referred to as the first Impressionist. Although he refused to consider himself as one of the Impressionists, Manet's work, which showed light by juxtaposing bright, contrasting



Georges Seurat, photographed in 1888.

colors, nonetheless greatly inspired and influenced the generation of artists following him. Manet's painting *Le Déjeuner sur L'herbe* (*Luncheon on the Grass*) (1863)—included in the *Salon des Refusés* in 1863, an exhibit of works rejected by the “official” *Salon*—was singled out for ridicule. The scandal surrounding this work resulted from its violation of the unwritten rule that the only appropriate nudes in contemporary art were classical figures or women in suitably exotic settings. In *Luncheon on the Grass*, Manet based his work on an engraving with a classical subject matter, but he showed contemporary clothed men with a nude woman as part of the group. This caused an uproar.

While Manet continued to submit his work to the *Salon*, other artists who disagreed with the rigid artistic standards espoused by the Académie des Beaux-Arts in Paris and favored by the *Salon* set about establishing Impressionism as a new style. A work by Claude Monet (1840–1926) was the source of the movement’s name. Monet showed a work that he called *Impression, Sunrise* (1872), and the critics seized on this mere “impression” as a means by which to ridicule the movement. It was Monet who urged his fellow artists to work outdoors, and these endeavors were aided by technical advances in paint and brush production that made the medium more

portable. Impressionist artists put their colors directly on the canvas with rapid strokes to capture the rapidly changing light. Scientific studies of vision and color led to the discovery that shadows were not merely gray but that they reflected the complementary color of the object casting them. Camille Pissarro (1830–1903) and Alfred Sisley (1839–99) were two other Impressionists of note.

Post-Impressionism and Other Late Nineteenth-Century Developments

The artists who followed Impressionism, though influenced by the earlier artists, took various features of Impressionism in quite different directions. The most influential of these artists was Paul Cézanne (1839–1906). Dissatisfied with the lack of solid form in Impressionist works, Cézanne set about redefining art in terms of form. He suggested that a painting could be structured as a series of planes with a clear foreground, middle ground, and background and argued that the objects in the painting could all be reduced to their simplest underlying forms—a cube, a sphere, or a cone. Here we should note the obvious influence that these ideas, presented first by Cézanne, later had on the development of Cubism in the early twentieth century.

The ongoing search for more and more brilliant color was a unifying feature for many of the **Post-Impressionists**. The work of Georges Seurat (1859–91) placed an emphasis on the scientific rules of color. Seurat applied his colors in small dots of complementary colors that blended in the eye of the viewer in what is called optical mixing. The results were vibrant, though the emphasis on technique also resulted in static compositions.

As Seurat was attracting attention and Cézanne was formulating his rules for painting, a young Dutch painter named Vincent van Gogh (1853–90) was studying art. Van Gogh, using theories of contrasting color and very direct application of paint, set about capturing the bright light of southern France. His vigorous brushwork and twisting forms were designed to capture an intense response, and though his career was short, many of his works have become very well known. Van Gogh developed the idea that the artist’s colors should not slavishly imitate the colors of the natural world, but should be intensified to portray inner human emotions. The intense and jarring yellows, greens, and reds in the poolroom of Van Gogh’s *Night Café* (1888), which van Gogh considered

a place of vice, illustrate this very influential idea.

The search for intense light and clear color also marks the work of Paul Gauguin (1848–1903), who is perhaps known as much for the story of his life as he is for his art. Though he was a successful stockbroker, Gauguin left his wife and family while in his forties to pursue his art career. He worked for a short time with van Gogh in southern France but was still dissatisfied with his art. Searching for more intense color and a more “unschooled” style, he went to Tahiti, where he painted works that depict the island’s lush, tropical setting and native people, as seen through the lens of colonialism.

At this juncture, it is important to note the outside influences that were affecting the changing art world. The invention of the camera called into question the very need to capture ordinary reality in art. Some of the most important inventions may seem quite mundane. The invention of chemically based paints and the paint tube allowed the Impressionists to paint outdoors easily for the first time. This was also a time of global exploration and colonialism, and the objects brought back from around the world had a profound effect on the Impressionists and the artists who followed. Artists were intrigued by masks from Africa, and many collected the Japanese prints that were used as packing for shipments of goods from Japan. Edgar Degas (1834–1917) was an Impressionist whose work exemplified these new influences. Degas often combined the snapshot style of photography with a Japanese-like perspective from slightly above his subject.

In England, a group of artists dissatisfied with the effects of the Industrial Revolution banded together and became known as the **Pre-Raphaelites**. These artists created a style that attempted to return to the simpler forms of pre-Renaissance art. The Pre-Raphaelites created many quasi-religious works that often blended Romantic, archaic, and moralistic elements. Their emphasis on nature and sweeping curves paved the way for **Art Nouveau**. Art Nouveau, which became popular in the late nineteenth and early twentieth centuries, was a style of decoration, architecture, and design that was characterized by the depiction of leaves and flowers in flowing, sinuous lines.

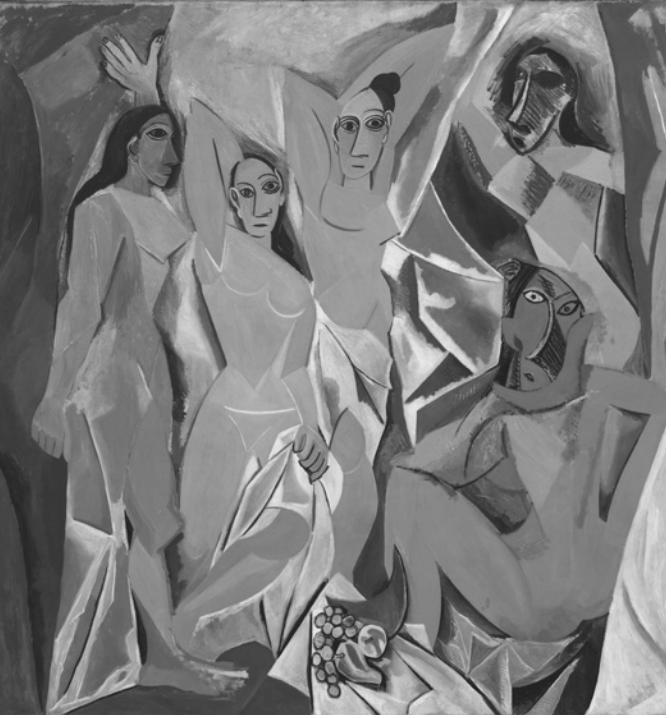
The Emergence of Modernism

As we move into the twentieth century, we see artists who were continually striving to discover new ways of presenting their ideas. Furthering the attempts the

Post-Impressionists had made to extend the boundaries of color, a group of artists led by Henri Matisse (1869–1954) used colors so intense that they violated the sensibilities of critics and the public alike. Taking their cue from van Gogh, these artists no longer thought their use of color needed to replicate color as seen in the real world. Their wild use of **arbitrary color** earned them the name of *fauves*, or “wild beasts.”

Natural form was to be attacked with equal fervor, as can be seen in developments in Paris around 1908. Pablo Picasso (1881–1973), in close collaboration with Georges Braque (1882–1963), was at work developing a whole new system of art. Picasso and Braque broke down and analyzed form in new ways in the style that came to be known as **Cubism**. Psychologists had explained that human experience is much richer than can be gathered from a traditional painting that shows a single view from a fixed vantage point. When we look at any given scene, we remember the scene as an overlay of visual impressions seen from different angles and moments in time. Picasso and Braque were familiar with these theories, as indicated by their habit of breaking figures up into multiple overlapping perspectives. The Cubists were also influenced by African art, which they imagined to be more intuitive and closer to nature than intellectualized European art. Cubist works reacted against the naturalistic, often sentimental, artworks that were popular in the late nineteenth and early twentieth century. The Cubists favored abstract forms over lifelike figures.

In Germany, an art developed that emphasized emotional responses. A group of artists calling themselves **Die Brücke**, which included Ernst Ludwig Kirchner (1880–1938) and Emil Nolde (1867–1956), took the brilliant arbitrary colors of the Fauvists and combined them with the intense feelings found in the work of the Norwegian artist Edvard Munch (1863–1944). This highly charged attempt to make the inner workings of the mind visible in art is known as **Expressionism**. Another Expressionist group in Germany, **Der Blaue Reiter**, was led by the Russian artist Vasily Kandinsky (1866–1944), who around 1913 began to paint totally abstract pictures without any pictorial subject. Other pioneers of total **abstraction** were the Russian painter Kazimir Malevich (1878–1935) and the Dutch artist Piet Mondrian (1872–1944), whose **De Stijl** canvases, consisting of flat fields of primary color, have become a hallmark of modern art.



Pablo Picasso's *Les Demoiselles d' Avignon*.

The next events in our story of the history of art are important because they mark the beginnings of modern art in the United States. It was these beginnings, coupled with the effects of the First World War, that were partly responsible for the eventual shift of the center of the art world from Paris to New York. While the movements of modern art were sweeping Paris, the American scene remained largely unaffected until 1913. The **Armory Show**, arranged by the Barnes Foundation and held from February 17 through March 15, 1913, was the first major showing of modern art in the U.S., and it caused a sensation. Artworks that were to become landmarks of various European art movements were a part of the Armory Show, and they had a profound and lasting effect on American art. Marcel Duchamp's (1887–1968) *Nude Descending a Staircase* (1912) and Picasso's *Les Demoiselles d' Avignon* (1907) both shocked viewers with their challenging approaches to the figure and space. Brancusi's (1876–1957) *The Kiss*, with its abstracted, block-like figures, and Kandinsky's non-objective paintings added to the outrage.

While the effects of the European works in the Armory Show rippled through the American art world, there was also a quintessentially American movement underway. During the 1920s, Harlem became a center for African-American creativity. Fueled by the popularity of jazz,

writers and artists joined musicians in a flowering of the arts that is called the **Harlem Renaissance**. Though the movement lasted only a decade, it was an inspiration to many artists, including Jacob Lawrence, Romare Bearden, and other well-known artists of the next generation.

During World War I and its aftermath, another movement arose that challenged established ideas about art. This movement, called **Dada**, originated among a group of disaffected intellectuals living in Zurich and grew out of the angst of artists who were disillusioned with the war. Dada was an art that aimed to protest against everything in society and to lampoon and ridicule accepted values and norms. Marcel Duchamp created two works that have come to represent this amusing and irreverent view of the world. He added a mustache to a reproduction of the *Mona Lisa* and gave it an insulting title (*LHOOQ*, 1919), and he also exhibited a common porcelain urinal (*Fountain*, 1917).

Duchamp, in fact, invented a new category of artworks that he referred to as **ready-mades**. By taking an ordinary object and giving it a new context, Duchamp would create a work of art. In this way, Duchamp challenged traditional ideas about the way the artist functions—rather than physically making a work of art, an object became a work of art merely through the artist's choice. Picasso created several works that may also be considered ready-mades. For example, in a famous work Picasso took an ordinary object—bicycle handlebars—and made them appear as bull horns when coupled with a bicycle seat (*Bull's Head*, 1943).

Some artists, influenced by the theories of Sigmund Freud, attempted to portray the inner workings of the mind in their artworks. This group of artists became known as the **Surrealists** and included artists such as Salvador Dalí (1904–89), René Magritte (1898–1967), and Joan Miró (1893–1983).

One of the most influential events in the history of art took place in Germany between the first and second world wars. A school of design called the **Bauhaus**—a name that would become a byword of modern design—established standards for architecture and design that would have a profound influence on the world of art. The Bauhaus made a bold attempt to reconcile industrial mass-manufacture with aesthetic form. Taking the view that form should follow function and should be true to the materials used, the faculty at the Bauhaus

designed a curriculum that continues to influence many contemporary schools of art. After the school was closed by the Nazis in 1933, many of the Bauhaus' faculty, including Josef Albers (1888–1976), a well-known painter, graphic artist, and designer, came to the United States and continued to teach. We can still recognize the Bauhaus influence in our contemporary society with its streamlined furnishings and buildings.

Abstraction

During World War II, organized movements in art came to a virtual standstill. Art was produced, but attention was really on the war. Many artists did in fact serve in the military, and often art was designed to serve as propaganda in support of the war effort. When the war was over and Europe was recovering, a new center for the international art world emerged. The action had shifted to New York, and it would be decades before the artistic centers in England, France, Italy, and Germany would regain something that approximated the prominence of New York.

During the 1950s, the art scene in New York was dominated by the ideas and writings of critics such as Harold Rosenberg and Clement Greenberg. These critics had a tremendous influence on the development of art styles. Greenberg chose to promote a particular view of art and was an advocate for artists who were further developing abstraction. Beginning in the 1940s, **Abstract Expressionist** artists followed Kandinsky's dictum that art, like music, could be free from the limitations of pictorial subject matter. These artists aimed at the direct presentation of feeling with an emphasis on dramatic colors and sweeping brushstrokes. The Abstract Expressionist movement, which included the artists Willem de Kooning (1904–97), Lee Krasner (1908–84), and Franz Kline (1910–62), reached its pinnacle with the work of Jackson Pollock (1912–56). Pollock eventually abandoned even the use of his paintbrush and instead dripped his paint directly onto the canvas.

Abstract Expressionist works tended to fall into two types: **Action Painting**, which employed dramatic brushstrokes or Pollock's innovative dripping technique, or **Color Field paintings**, which featured broad areas of color and simple, often geometric forms. Mark Rothko and Josef Albers are two well-known color field artists.

In response to the non-objective style of Abstract Expressionism, other artists began to return to



Robert Rauschenberg's Monogram.

naturalism, producing works that, though they may appear in some ways similar to those of the abstractionists, focused on ordinary consumer objects. Jasper Johns (b. 1930) created a series of works that featured common things such as flags, numbers, maps, and letters. Robert Rauschenberg (1925–2008) created sculptures from the cast-off objects he found around him to create what he called "combines." He hung his own bedclothes on the wall like a canvas and painted them [*Bed* (1955)], and one of his most famous works, *Monogram* (1959), consists of numerous "found" items, including a stuffed goat, a tire, a police barrier, the heel of a shoe, a tennis ball, and paint. This use of everyday objects in artistic works had a decided influence on the next big movement in art—Pop Art.

Pop Art, Minimalism, and Photorealism

1960s **Pop Art**, with its incorporation of images of mass culture, violated the traditional unspoken rules regarding what was appropriate subject matter for art. Andy Warhol (1928–87), the icon of pop art, achieved the kind of popularity usually reserved for rock stars. His soup cans, Brillo boxes, and images of movie stars were created with a factory-like silkscreen approach that he used to mock the art world. Roy Lichtenstein (1923–97), another pop artist, adopted the imagery of comic books and recreated them on such a large scale that the pattern of dots used to print them was made massive. Robert Indiana (1928–2018) used stencils that had been originally used to produce commercial signs to create his own artistic messages.

Minimalism sought to reduce art to its barest essentials, emphasizing simplification of form and often featuring monochromatic palettes. The invention of acrylic paint and the airbrush enabled Minimalist painters to achieve very precise outlines, which resulted in the term “hard-edge painting.” The artist who is best known for these large, entirely non-objective paintings is Frank Stella (b. 1936). The sculptors David Smith (1906–65), who used stainless steel, and Dan Flavin (1933–96), who used neon tubing, also created large pieces that reflected this abstract minimalist sensibility.

A Pop-inspired group of artists began to produce works that aimed to create a kind of super-realism or what came to be called **Photorealism**. In these works, a hyper-real quality results from the depiction of the subject matter in sharp focus, as in a photograph. This technique offered a clear contrast to the use of sfumato, developed in the Renaissance, which had added a haziness to the contour of painted objects. Photorealist artists Chuck Close (1940–2021), with his portraits, and Duane Hanson (1925–1996), with his witty sculptures of ordinary people, hearkened back to the Realism promoted by Gustave Courbet.

Earthworks, Installations, and Performance

One intriguing development in the contemporary art world since the 1970s is that art is no longer limited to gallery or museum spaces, and many important works of art are departures from traditional formats. Some artists have taken their work to a new scale and have developed their artworks in new venues, often out of doors. In this way, artists also challenge conventional ideas about art and its function. An artist known by the single name Christo (1935–2020), working together with his partner Jeanne-Claude (1935–2009), is responsible for creating much interest in these kinds of **Earthworks** (also known as Land art or Environmental art). Beginning in Europe, Christo startled the world with the idea that landscape or architecture is something that can be packaged. He wrapped several well-known monuments in fabric, built a twenty-four-mile-long cloth fence in California, surrounded eleven Florida islands with pink plastic, and set up orange fabric gates on pathways throughout Central Park. These works, which require years and even decades of preparation, are as much about the process as they are about the finished product, and it is for this reason that Christo’s partner, Jeanne-Claude, played such an important role. While

Christo designs the projects, Jeanne-Claude handled many of the logistical details that must be addressed to carry out the work. Their partnership raises important questions about the concept of the individual genius of the artist and how he or she works. Other artists associated with Earthworks are Michael Heizer (b. 1944) and Robert Smithson (1938–73).

The growth of **Performance Art** is another development that allows artistic expression to transcend traditional boundaries. Some artists work in conventional media such as photography and painting, as well as in performance art. Performance art is a combination of theater and art in which the artists themselves become the work. Such works exist in time, like music or theater, and are fleeting and transitory in nature. The point is to create a real event in which the audience can participate, but that does not result in a fixed, marketable artwork for a museum or living room wall. Sometimes performance art is socially conscious in its intent. An example is the Guerrilla Girls, a group of New York-based artists who began to work together in 1985. The individual identities of the artists in this all-female group are kept anonymous at all times. The artists even wear gorilla masks when they appear in public to conceal their identities. The artists use guerrilla-warfare tactics, such as pasting up posters and flyers, as well as giving public speeches, to challenge what they see as an art world dominated by white men.

Postmodernist art arose in reaction to the modernist styles, and not surprisingly, it takes many forms across a variety of media. Postmodern works tend to reintroduce traditional elements or to exaggerate modernist techniques by using them to the extreme. Postmodern works often return to earlier styles, periods, and references and often question the mores and beliefs of contemporary society. A leading proponent of Postmodernism in architecture is Philip Johnson (1906–2005), who at one time was known as one of the leading modern architects of the International Style. For decades, architecture had largely been dominated by the Bauhaus idea of form following function, and sleek towers of steel sheathed in glass were the standard for large buildings. But, in 1970, Johnson suggested the radical idea that one of the functions of art was decoration, and with the AT&T Building (1984; now 550 Madison Avenue), he added a finial to the top of the standard office tower.

Today, artists around the world work in an endless

variety of media and styles. One can no longer say that any particular city, country, or even continent is the “center” of the art world. The next section of this guide provides a brief overview of “nonwestern” art, but we should note that the categories of Western and nonwestern in the world of contemporary art are becoming obsolete with the emergence of transnational artists in an increasingly mobile and interconnected world.

BRIEF OVERVIEW OF NONWESTERN ART

The story of art that we have been studying thus far has been a traditional one and has been told over and over again by countless writers since Giorgio Vasari’s time. It chronicles a history of Western European ideas that grew out of the concepts put forth by early Greek philosophers. These ideas experienced a revival during the Renaissance and were further refined in the seventeenth and eighteenth centuries. Atomic power, the increasing pace of technological inventions, and the electronic age further expanded and changed the realm of art in the twentieth century.

We should keep in mind that the history we have chronicled thus far, though valuable, has clear limitations. In recent decades, art history, like many other academic disciplines, has been challenged to include artists and works that were previously marginalized. The influence of feminist critics in particular has led to major revisions, and there has also been an increasing inclusion of the histories of art of other cultures. At this point, we will look at the arts of Asia, Africa, Oceania, the Americas, and the art of Islam throughout the world. The art histories of these cultures are increasingly central to the development of the discipline of art history. Of course, this brief survey covers only a tiny fraction of the rich world of art beyond the boundaries of the Western world. The works considered here might be categorized as “traditional”; contemporary art from Asia and Africa, thoroughly immersed in the global art scene, is beyond the scope of this discussion, for example. Illustrations of the works of art discussed here can be found through basic Internet searches and in standard art historical textbooks.

Asian Art **Chinese Art**

Civilization and art have been present in China for thousands of years, and some archaeological finds in

China rival those in Mesopotamia and Egypt. Remains of painted wares have been found that date back to the fourth millennium BCE. Perhaps the most famous work of ancient Chinese art is the [Great Wall](#), which was constructed over the course of centuries and covers thousands of miles. Of course this wall, now considered an enduring work of art and admired both for its engineering and aesthetic appeal, originally had a utilitarian function. This is an example of how meaning and function can change over time. In fact, many of the works we will examine here were created for a specific purpose but are now seen as works of art in a different context.

The dynasties or kingdoms that ruled for long periods of time had an impact on the history of art in China. In many cases, these rulers left elaborate tombs that contained many objects that have become great treasures of art. One of the most amazing works from the early period of Chinese art history is the monument to the first emperor to unite the kingdom—the Emperor of Qin (c. 210 BCE). He had a full army of soldiers and their equipment, including their horses, created life-size in clay and buried as part of his tomb. The technical ability demonstrated in these sculptures and the life-like detail of the soldiers and their horses are quite astonishing. The dynasties succeeding Qin built grand walled cities with huge palaces and tombs. These dynasties are noted for bronze statues and ceremonial vessels. These vessels are covered with intricate designs, and the methods of casting are still not completely understood.

The introduction of Buddhism from India had a profound effect on Chinese arts and culture. During the reign of the Tang Dynasty (618–907 CE), often referred to as China’s Golden Age, artists produced some of the greatest works of ceramic sculpture ever made. Traditional Chinese art also placed great value on ink drawings. Many scrolls are meant for contemplation, and this contemplative aspect is a feature often associated with Asian art. Chinese traditions in writing, painting, and sculpture were maintained over the centuries. With the communist revolution that established the People’s Republic of China in 1949, art became suffused with political ideas and was often an instrument of propaganda. However, since the late 1970s, Chinese art has gradually become less political.

Indian Art

India is an extremely diverse nation in which more than



The terracotta army was buried with the First Emperor of Qin.

1,600 different languages and dialects are currently spoken, and India is home to a variety of religious and cultural traditions. India's artistic traditions are among the oldest in the world, and here we will only be able to touch on one or two aspects of India's rich artistic heritage. The influence of Buddhist traditions is strong, of course, but what often astonishes people unfamiliar with the art of India is the influence of Greek art on the classical images of Buddha. India has ruins of great early civilizations that rival those of Egypt and Mesoamerica, and the sensuous style of Indian sculptures has had an enduring impact on art over the centuries. Much Indian art reflects the tremendous influence of Hinduism. This religion, with its many gods and goddesses, gave rise to a lovely, lively, and sinuous style. Images of Shiva, who dances gracefully with his multiple arms, are particularly striking.

Japanese Art

The island kingdom of Japan, though tiny in size, has had a great influence on the international art world. Japan was closed to the West for the majority

of its history, and this allowed Japanese art to remain relatively consistent and traditional. As with China, the history of Japan is one of succeeding dynasties, with each one leaving its mark in a series of succeeding styles. Also, as with China, Buddhism was imported to Japan and became an important focus in the traditional arts. The strength of Japan's artistic traditions remained even when the country became more open to Western cultures. During the rise of the Impressionist movement in Europe, Japan sent a group of artists to study in France. These artists returned to Japan and introduced the ideas they had encountered in the West, and so, for a short time at the end of the nineteenth century, there was a group of artists in Japan who used linear perspective and the colors and subjects of Impressionism. However, what is noteworthy is that the Japanese soon rejected these ideas and returned to the isometric perspective and flat areas of color favored by Japanese traditions. Although Japanese artists created excellent works in painting, architecture, crafts, and sculpture, it is for their printmaking that Japanese artists are best known in the Western world. Japanese prints had a profound influence

on Western art, as French artists began to imitate the prints that they began to collect in the late nineteenth century. The flat colors and overhead viewpoint of these prints were adopted by many French artists during this period.

African and Oceanic Art

Some of the historic traditions of African art have already been discussed in our survey of Western art. As a result of the relationships between Egypt and the Mediterranean world, the ancient arts of northern Africa are often incorporated into the history of Western art. Usually the art of sub-Saharan Africa is treated separately from that of northern Africa because of the regions' very different histories. A close look at all areas of the continent reveals that impressive art traditions emerged in west, central, east, and southern Africa quite early. Some of the oldest examples are cave paintings in what is now Namibia. In West Africa, the Nok civilization flourished from c. 900 BCE to 200 CE. Located in what is present-day Nigeria, this impressive civilization produced fantastically life-like terracotta sculptures, many of which were probably portraits of political and religious leaders. It is possible that the early Nok civilization had an influence on later cultural groups such as the Yoruba.

Another important historical tradition from Nigeria relates to the Benin Kingdom, which first emerged around 900 CE when the Edo people settled in the area. The kingdom became further consolidated with shifts in leadership in the eleventh century. Much of the remaining art from the Benin Kingdom was produced in association with a rich life at the royal court. Cast bronze portrait heads were intended for ancestral altars, and a variety of objects were made to reinforce the tremendous power of the oba, or Benin king. Countless treasures from the Benin Kingdom were destroyed or confiscated by the British in the 1897 raid on the royal palace. As a result, many more of these objects from historic Benin can be found in museums in Europe and the United States than in Nigeria.

While art objects in a variety of media have been created by many different African cultural groups, our study of them has been limited in many cases by the lack of necessary conditions for preservation. While there are some objects in metal and clay, the use of fiber and wood, which are quite perishable, has resulted in relatively few artifacts being preserved. Unfortunately,



A Fang mask used for the ngil ceremony, an inquisitorial search for sorcerers. Wood, Gabon, nineteenth century.

much African art was also destroyed by early European traders and colonial settlers on the continent. Westerners often viewed much of what they found in Africa as dangerous and threatening to the colonial pursuit, perceiving artworks as pagan symbols that should be destroyed rather than preserved. Hence, a wealth of cultural artifacts has been lost. The objects that were preserved were often collected as archaeological artifacts and, in most cases, important contextual information was lost. It is only relatively recently that art historians have begun to explore the rich variety

of artworks and aesthetic systems of African cultures. In many cases, traditional African arts challenge the Western concept of art for art's sake—functional baskets, ceramics, and textiles, for example, are some of the most prized material objects for many African cultural groups.

When we look at African art in a museum, a great deal of contextual information that is crucial to our understanding of the object is lost. Many African cultural groups, such as the Dan and the Bwa, are well-known for their impressive masks. Masks, though, are not meant to be seen in isolation as they are typically displayed when in art museums. Instead, masks are usually integrated into performance, coupled with a full-body costume and accompanied by music, dance, jokes, festivities, and a great meal shared with friends and family. It is difficult, of course, to recreate all of this in a museum context!

Similar issues occur in relation to the arts of Oceania. Oceania is the collective name for the thousands of islands that constitute Polynesia, Melanesia, and Micronesia. As is the case with Africa, many perishable objects dating back for centuries have been lost to us due to the use of fragile materials in a sometimes hostile climate. In Polynesia, tattooing and other body arts were important ways of expressing social stature. Clearly these art forms are lost with the death of the tattooed person and were preserved only through engravings made by visitors to the islands prior to the invention of photography.

Some of the most important art traditions of the Asmat cultural group of Melanesia relate to warfare. Traditionally the Asmat engaged in head-hunting practices, but these traditions have died out. Enormous carved wooden shields decorated with beautiful black, red, and white abstract patterns were traditionally used for protection in raids among groups throughout the area; today these shields are seen as cultural symbols, but they no longer serve the same function in war.

Carved masks were a central part of Melanesian cultures. In many cases, these masks were used in ceremonies that involved summoning the spirits of ancestors to honor the dead. As is the case with African art traditions, much is lost when these objects are viewed in museum collections.

Rich traditions continue to develop throughout Oceania

today, especially as groups such as the Maori of New Zealand seek cultural renewal by reviving old traditions in a new context. Many people from traditional cultural groups that have been threatened by colonization recognize that art offers vibrant possibilities for expressing and reinforcing cultural identity.

Islamic Art

Today, Islam is a major religion that is not limited to any one region of the world. However, historically Islam emerged in the Arabian Peninsula following the teachings of the prophet Muhammad (c. 570–632). The revelations of Muhammad are recorded in Islam's holy book, the Koran. This text plays a central role in the practice of Islam, and some of the most valued art objects are beautifully produced copies of the Koran or containers that hold the sacred text. Following the Koran's scriptures, Islamic art is largely non-figurative. Abstract or calligraphic decoration can be found on most Islamic art objects, including sacred architecture, which has a long history in the Islamic tradition. The [Dome of the Rock](#) in Jerusalem (687–692) is one of the oldest examples of Islamic architecture. Its position in Jerusalem marks the presence of Islam in a city that is also sacred to Jews and Christians. The act of prayer is central to the practice of Islam, and the mosque, with its *qibla* wall facing toward Mecca, emerged as a site for communal prayer. Mosque architecture can be found in a variety of forms throughout the world today.

The Americas

For many years art historians classified much of the art of North and South America as products of simple craftsmanship. These artifacts were not truly considered works of art and therefore were kept solely in archeological and anthropological museums. However, renewed interest and new studies of these works have added considerably to our understanding and appreciation of the art of the first Americans, and objects from these cultures are becoming more and more common in the collections of art museums. Great civilizations grew and flourished in the Americas, including the Olmec, Toltec, Maya, Inca, and Aztec. Great pyramids, rivaling those of Egypt, rose as the central features of large cities, of which the Pyramid of the Sun in Mexico is one of the best known. The decorative carvings on the Mayan ruins continue to amaze us, and in addition to architectural marvels, statues in clay and stone, as well as fine textiles and jewelry, remain as reminders of the glories of these



An image of the Dome of the Rock from Phillip Baldensperger's "The Immovable East: Studies of the People and Customs of Palestine," published in 1913.

civilizations.

While there is evidence of early people in many areas of present-day Canada and the United States dating back nearly 12,000 years, several of the conditions that we identified earlier as being necessary for preservation were not present. As a result, the majority of artifacts from these cultures are only from the last two thousand years. During the later centuries of the prehistoric period, the Native Americans of the Southwest demonstrated remarkable architectural skills in the building of **pueblo** complexes. These dwellings often consisted of well over a hundred rooms laid out in multiple stories.

ELEMENTS OF ART

Formal Qualities of Art

While it is crucial to examine any given work of art in its historical context in order to arrive at an understanding of its meaning, it is also important

to focus intently on the formal qualities or the basic visual components of a work of art. These include **line**, **shape**, **form**, **space**, **color**, and **texture**, among other things. Formal analysis requires careful observation and description, often using the special vocabulary of art.

Line

Line is the most basic of art elements. Any kind of mark-making tool—a finger, pencil, paint, etc.—can be used to create a line on a surface. The strict definition of a line is the path of a point moving through space. But beyond this technical definition, lines have a variety of characteristics such as length, width, and direction. Lines may appear hard or soft, bold or indistinct, uniform or varying in width. Sometimes lines are not solid but consist of a series of interrupted dots or lines that the eye connects to create an implied line. Think of prints in the sand or snow that imply the path of a person or animal. Sometimes we see the edges of objects as lines. The corners of rooms, the

edges of doors, and the line where two colors meet all provide examples of how edges may be seen as lines.

Artists use lines to express ideas or feelings visually. Horizontal and vertical lines create a stable and static feeling. Vertical lines cause the eye to move upward. Medieval churches were created with very high arched ceilings, designed to raise the eyes of the people upward toward heaven to promote a feeling of spiritual awe. Horizontal lines, such as the line of the horizon, suggest a feeling of peace and tranquility while curving and jagged lines create a sense of activity. Though the use of lines is perhaps most essential and noticeable in drawing and some kinds of printmaking, all artists use line in their artwork in some way.

Shape and Form

Shape and form are two elements of art that are closely related to one another. Shape is what defines the two-dimensional area of an object, whereas forms are objects that are three-dimensional, having length, width, and depth. For example, a square is a shape, but a cube is a form. A triangle is a shape; a pyramid or a cone is a form. When one draws an apple that in nature is a form, one draws a shape that represents the apple. If one creates an apple out of clay, that clay apple is a form. In a two-dimensional artwork, an artist may try to create the illusion of form through the use of shading, foreshortening, perspective, and other techniques.

Shapes and forms may be geometric, such as circles/spheres and squares/cubes. These geometric shapes and forms can be defined mathematically and are precise and regular. Some shapes and forms are described as being “organic” since living things tend to be freeform and irregular in shape or form. A geometric shape or form can convey a sense of order and stability, while organic shapes and forms tend to express movement and rhythm.

Space is an element of art related to the organization of objects and the areas around them. The objects, shapes, or forms in an artwork occupy what is termed **positive space**. Sometimes these objects, shapes, or forms may be called the figure. The area around these objects, shapes, or forms represents negative space. In three-dimensional forms, **negative space** may surround the forms or may be created as a result of open spaces within the forms. Three-dimensional artworks include, among other forms, architecture, ceramic objects, and sculpture. The two primary types of sculpture are

freestanding, or fully in the round, and relief, meaning that the sculpture projects from a surface or background of which it is a part. Such sculptures may be in high relief—projecting boldly from the surface—or bas (low) relief—projecting only slightly from the surface of the sculpture.

Perspective

The creation of perspective or the illusion of depth is another important use of space in two-dimensional artworks. There are many effective techniques that artists can use to create an illusion of three-dimensionality. They may use shading and highlighting on the contours—the visible borders—of objects to replicate the manner in which light shining on objects lends those objects a sense of volume and space. An artist can also create a sense of depth in an artwork by placing objects or figures lower on the picture plane to make them appear closer to the viewer. Or, one can do the reverse and place objects and figures higher on the plane to make them appear farther away from the viewer. Artists can also manipulate the size of objects to create a sense of perspective—larger objects will appear closer to the viewer than smaller objects. An artist can also have closer objects overlap objects that are farther away to indicate depth and distance. Moreover, the artist can make objects appear closer to the viewer by giving them greater detail than objects that are farther away—replicating the manner in which our eyes are able to perceive more detail in objects that are nearer to us.

Aerial perspective, also called atmospheric perspective, is a technique that takes into account the ways that fog, smoke, and airborne particles change the appearance of things when they are viewed from a distance. When an artist uses this technique, objects that are farther away will appear lighter and more neutral in color and will lack contrast of color or value.

Frequently, when we think of perspective, we think of the mathematical techniques that were developed during the Renaissance which can be used to create the illusion of space. Such techniques create what is called linear perspective because this perspective is founded on the visual phenomenon that as lines recede into the distance, they appear to converge and eventually vanish at a point on the horizon. We may, for example, notice this effect when viewing highways, railroads, or fence posts as they stretch into the distance. In employing linear perspective, the artist establishes



Pietro Perugino's use of perspective in this fresco at the Sistine Chapel (1481–82) helped bring the Renaissance to Rome.

one or more vanishing points on the real or imagined horizon of the artwork. Then, lines are carefully drawn to ensure a precise and extremely realistic depiction of interior and exterior scenes. Thus, in drawing a black and white checkerboard floor (a frequent feature in Renaissance interior paintings), the horizontal lines of the tiles are drawn as parallel, but the vertical lines—which we know are also parallel in reality—appear to converge or come together in a systematic way as they recede toward the back wall of the interior.

Color

Color surrounds us wherever we go and is a compelling element in art. **Hue** is simply the name of the color. There are three primary colors—red, blue, and yellow—from which all other colors are produced. Secondary colors are formed from the mixture of two primary colors: red and yellow make orange; yellow and blue make green; blue and red make violet. There are six tertiary colors, made by combining a primary and an adjacent secondary color: red and violet make red-violet; violet and blue make violet-blue; blue and green make blue-green; green and yellow make yellow-green; yellow and orange make yellow-orange; orange and red make red-orange. The organization of

these hues into a visual scheme, known as the **color wheel**, dates from the eighteenth century, though the underlying concepts were developed by Sir Isaac Newton in the seventeenth century. The color wheel is a useful tool for predicting the results of mixing hues.

Two important variables affecting color are the amount of light that is reflected and the purity of the color. The term “**value**” is often used when discussing the lightness or darkness of a color or of gray. Values in an artwork may be primarily dark or primarily light or may be contrasting from dark to light. The artist’s use of value contributes to the expressive quality of the artwork. In mixing colors, artists create a lighter hue by adding white to the color. Adding white to red, for example, makes a lighter red or pink. Artists create darker hues by adding black to the color. Adding black to red, for example, makes a dark red. A few words about black and white are necessary at this point. Black and white are not hues; they are called **neutrals**. When mixing black and white, artists can create a continuum of grays.

Intensity refers to the brightness or purity of a color. The unmixed primary colors, being pure in color, are generally considered to be the most intense colors.

If pure colors are mixed, they become less intense. Adding black or gray to a color will reduce its intensity. Adding a color to its complement lowers the intensity of the color, making it more dull or neutral in tone. Equal parts of two complements, such as red and green, will produce a dull, muddy brown tone.

Artists often use specific color schemes to produce particular visual or emotional effects. In the nineteenth century, scientists discovered the relativity of color; they determined that a given shade of red will look brighter or darker, more or less intense, depending on what other (similar or contrasting) colors are placed next to it. Thus, colors do not have a fixed or immutable character or value.

In discussing art and color, we often speak of warm colors and cool colors. These color associations are culturally constructed and are not absolute. In the context of Western art, warm colors include red, orange, and yellow and are referred to as such because we associate them with the warmth of the sun, the heat of a roaring fire, or the dry grass of a late summer day. Cool colors—green, blue, and violet—remind us of cool forests, mountain lakes, and snow. Artists often use warm and cool colors to create space in artworks. Warm colors seem to advance toward the viewer while cool colors appear to recede. By employing contrasts of warm and cool colors, artists can create a sense of movement as the viewer's eyes move over the surface of the artwork.

Color may be local, arbitrary, or optical. **Local color** refers to the “true” color of an object or area as seen in normal daylight, irrespective of the effects of distance or reflections from other objects. For instance, in a work using local color, a grassy field would be green despite the fact that it may, in reality, appear bluish from a distance. **Optical color** refers to the effect that special lighting has on the color of objects. Consider how colors change in moonlight, at daybreak, in candlelight, or in artificial lighting. Artists who use **arbitrary color** choose colors for their emotional or aesthetic impact. In the twentieth and twenty-first centuries, artists have come to use arbitrary color schemes more and more often.

Texture

Texture refers to how things feel or how we think they would feel if touched. From a young age we explore the surfaces of things and store away these tactile

experiences in our memory. When we see new objects or artworks, we call upon our previous experiences to determine the quality of the surface texture. In the context of art, we make reference to two kinds of texture: actual and visual. Some artists use actual textures in their art. For example, a ceramic artist may create an actual texture on the surface of a pot or plate. In collages, assemblages, or masks, artists may use yarn, rope, shiny paper, shells, and other natural or manufactured materials to create actual textural effects. Artists who work in three-dimensional media exploit the textural qualities of their chosen material whether it is stone, wood, metal, or some other substance.

Artists who work in two-dimensional media create visual texture—an illusion of a textured surface—in their artwork. For example, an artist may wish to simulate the actual texture of a straw hat, a glass vase, or an orange. Textures may be created by using patterns of lines or shapes that suggest texture. An artist can use the contrast of light and dark on a surface to create a texture that appears rough. Conversely, the absence of such a contrast will evoke a smooth texture. Shiny surfaces appear to reflect light while matte surfaces appear soft and dull. In addition to using the aforementioned techniques to create visual texture, painters can create actual texture with their brushstrokes.

Composition

Composition refers to the artist’s organization of the elements of art, whether in two- or three-dimensional works. When speaking of a painting, the composition refers to the arrangement of these elements on the picture plane. In the case of architecture, composition is a word used to describe the organization of these elements in space.

Rhythm is the principle that we associate with movement or pattern. Artists create a sense of movement or rhythm in their artwork through the repetition of elements such as line, shape, color, and texture. The rhythm of a composition can cause the viewer’s eye to move rhythmically across and around the composition. Some rhythms flow smoothly, while others are more jarring. The artist directs the movement of our eye through the use of repeated elements.

Motif and pattern are two aspects of repetition. A motif is a single element of a pattern. For example, in a quilt design, one or more motifs are repeated to create

an overall pattern. A pattern involves the repetition of certain elements—color or line—or motifs within a work of art. Many patterns feature regular repetition. Shapes or motifs may be repeated in a number of ways to create regular patterns. Some kind of grid system will underlie a regular pattern. Checkerboards offer an example of a regular pattern.

Balance refers to the equal distribution of visual weight in a work of art. There are a number of techniques that artists use to create balance. The easiest to comprehend is symmetrical balance—a balance achieved when elements of the composition are repeated exactly on both sides of the central axis. If you fold a paper in half vertically and one side of the centerfold is a mirror image of the other side of the centerfold, then you have an example of symmetrical balance. Many formal styles of architecture make use of symmetry with columns, wings, and windows arrayed equally on either side of the central entrance. Artworks in which the central axis is horizontal and equal visual weight is placed above and below that axis also exhibit symmetrical balance. To avoid the rigidity and monotony that may accompany a symmetrical composition, many artists employ **approximate symmetry**. In this kind of balance, shapes or objects are slightly varied on either side of the central axis. The artist may also include variations in the color, detail, or position of the shapes to achieve this effect.

Asymmetrical balance is a visual balance that is achieved through the organization of unlike objects. Even though asymmetrical balance may appear to be more informal than symmetrical balance, it is actually a more complex compositional task. There are several ways that asymmetrical balance can be achieved. The first is by the position of objects. Think of two people of unequal weight on a seesaw. To maintain a balance, the lighter person must sit far out on the end of the seesaw while the heavier person must sit close to the fulcrum. Similarly, an artist may create balance by placing the heavier, more solid object close to the center of the artwork while placing smaller objects farther away from the center.

Contrast of color, value, shape, size, line, or texture creates interest to the eye. An element that contrasts with the rest of a composition will create a **focal point** where the eye tends to rest. This focal point appears more dominant, more important than other parts of the composition. In this way, the artist may guide the

viewer to an understanding of meaning.

Proportion refers to the size relationships among the parts of a composition. Our sense of proportion is based upon our human scale. **Scale** refers to the dimensional relation of the parts of a work to the work in its entirety, and can refer to the overall size of an artwork. Size attracts our interest. The vast scale of the ceiling of the Sistine Chapel creates a sense of awe. The detail of a tiny painting or of illuminations in medieval manuscripts intrigues us. Artists consider the purpose and place of their art when determining the appropriate scale for the work.

Scale also refers to the relative size of elements within the artwork. In a naturalistic work, we expect that the relative sizes of the objects depicted will appear as they actually are in life. In some cases, artists intentionally make one person or object in their composition larger to draw our attention to that person or object.

When representing the human face and figure realistically, artists strive to use accurate proportions. The standards for the relationship of the various parts of the human face and body were established nearly 2,500 years ago during the Classical Period of Greek sculpture. The Greeks believed that the human figure was the measure of all things. As a consequence, all structures were designed in proportions relative to human proportions, and specific rules were established. For example, the ideal human figure was determined to be seven and one-half heads high. The features of the human face could be correctly placed according to these rules: the corners of the eyes fall on a line halfway between the chin and the top of the head, the bottom of the nose falls halfway between the chin and the corners of the eyes, and the bottom of the lips falls halfway between the chin and the bottom of the nose. However, many artists at different times have altered these proportions to reflect changing ideals of beauty. At other times, artists have exaggerated or distorted proportions for an expressive effect.

To truly understand how artists manipulate the elements of art and the principles of composition, it is necessary to examine a great many artworks and to analyze how artists create meaning in their artwork through skillful choices and the application of these artistic concepts. Students should keep in mind that many of the elements discussed in the principles of composition section of this guide are more often found

in traditional works than in modern artworks. The rejection of notions such as unity and balance is often the very essence of much modern art.

PROCESSES AND TECHNIQUES

Two-dimensional art processes and techniques are those that are created on a flat plane. They have height and width, but not significant depth. These include drawing, printmaking, painting, photography, and some mixed media. Artworks that have depth as well as height and width and that exist in space are three dimensional. This category includes sculpture, other works in mixed media, and environmental art.

Drawing

Drawing is arguably the most basic of art processes. Most of us have been drawing since we could hold some tool and make marks on a surface. The most common drawing media are pencil, pen and ink, charcoal, crayon, and felt-tip pens. Artists can choose from a variety of surfaces upon which to draw. Early artists used walls of rock, and though some artists today continue to draw on walls, most use some kind of paper—from the white paper of common sketchbooks to a wide variety of manufactured and handmade papers. Papers may be smooth or rough, white or in a wide range of colors. Drawing tools may be black, colored, or white.

Drawing is primarily based on the use of line. Lines created by drawing media can vary dramatically in quality. Hard pencils will make thin, light lines while soft pencils will make thicker lines that may vary considerably in value from lighter to very dark. Charcoal is so soft that the color of the paper used will show through in places where the strokes are applied lightly. Each drawing tool or medium has its own unique qualities, and experimenting with a variety of drawing media is a good way to gain an understanding of their similarities and differences.

With drawing pencils or charcoals, a change in pressure will cause a change in value. More pressure creates darker values; lighter pressure creates lighter values.

Shading can also be used to change values. Artists use the techniques of **hatching** and **crosshatching** to shade objects and create an illusion of three-dimensionality. Hatching consists of placing lines closely side by side. Crosshatching is a process in which lines are crisscrossed to create shading. Many drawing media

can be blended to change their value and enhance shading. Another technique for shading is **stippling**. With this technique, the artist creates different values by making a pattern of dots. The distance between the dots determines how dark the shading will be—the more densely clustered the dots, the darker the shading.

When an artist uses ink as a drawing medium, the ink can be thinned to create a wash of lighter value in which the paper shows through to lighten the effect. Undiluted ink is opaque; it is not transparent, and it completely covers the underlying paper. But water can be added to make the ink translucent.

Color may be introduced into a drawing with the use of pastels or colored pencils. The same techniques used with black media are used with colored media. The artist using color must consider the effects of color and line in an artwork. Colored pastels became popular in the 1700s. These soft sticks of color can be readily blended to create delicate tints and shades, and they are particularly popular for portraiture. The major drawback of pastels is that they are very fragile, and pastel drawings must be cared for quite gently. Often, the surface of a pastel drawing is sprayed with a fixative to reduce the risk of smearing. Colored pencils are more durable than pastels, but like pastels, they may be layered to create blended colors.

Printmaking

Printmaking refers to a group of mechanically aided two-dimensional processes that permit the production of multiple original artworks. The principal printmaking processes include relief prints, intaglio prints, lithographs, and **screen prints**. All of these processes use some sort of printing plate (a “matrix”) on which an image is created. Ink is applied to the plate, and the image is transferred to paper or another material.

In **relief printmaking**, the artist cuts away parts from the surface of the plate. The matrix may be made of wood, linoleum, or a synthetic material, and a number of tools, including woodcarving or linoleum knives and gouges, can be used for cutting its surface. Once the plate has been cut, the remaining parts will stand out in relief. The relief sections may range from thin lines to broad fields, and it is these areas, when they are inked, that will produce the image. Wherever part of the plate is removed, the original color of the paper being printed upon remains. Ink is rolled over the surface of the plate with a brayer, and paper is placed over the inked plate.



*This engraving, titled *Veronica*, by Albrecht Dürer features hatching (e.g., background) and cross-hatching in many darker areas.*

The plate and paper are then put into a press or rubbed with a burnisher to force the ink onto the paper.

Intaglio printmaking works in the opposite manner from relief printmaking. In the intaglio process, lines are incised on the wood or soft metal plate. Line is an essential element in the intaglio process. Carving tools are used to cut lines into the surface of the plate in a process called **engraving**. Another intaglio process is **etching**. In this process, the design is incised through a layer of wax or varnish applied to the surface of a metal plate. After the incising, the plate is immersed in acid, which etches, or eats away, the exposed metal. Leaving the plate in the acid for a shorter time will make faint lines in the plate, while leaving the plate in for a longer time will make deeper grooves. After the plate is etched, the remaining wax or varnish is removed, and ink is forced into the etched areas of the warmed plate. Then, the ink on the surface of the plate is wiped off, and finally, paper is placed on the plate, and it is passed

through a heavy press. The paper is forced into the etched, inked areas, and the ink transfers to the paper. In an etching, the printing process causes the printed areas to actually rise above the surface of the paper, giving a degree of dimension to the print.

Lithography is a process in which the image is drawn with a waxy pencil or crayon directly on a plate, which can be made of stone, zinc, or aluminum. The greasy image is hardened, and the plate is saturated with water. Then, ink is applied. The ink adheres only to the greasy image since oil resists water. The image is picked up on the paper when the plate is moved through a press. Lithography can be a complex and demanding process, but in contrast to woodcut and engraving, it does not require special professional training; anyone who can draw can make a lithograph.

Screen prints are familiar to most of us since this is the process used to print most T-shirts. In the silk-

screening process, a photograph or other image is transferred or adhered to a silk or synthetic fabric that has been stretched onto a frame. The image serves as a sort of stencil, blocking out areas of the permeable fabric. When ink is forced through the fabric using a squeegee, at those areas not blocked by the stenciling, the image is transferred to the paper or fabric beneath.

Because multiple originals can be made through printmaking processes, the cost of an individual print is considerably less than that of a painting. Printmaking techniques have been used in the print industry for illustrating newspapers and books since the development of the printing press in the fifteenth century.

Painting

Painting encompasses a wide variety of media and techniques. Paint is usually composed of three different materials: **pigments**, **binders**, and **solvents**. Pigments are finely ground materials that may be natural or synthetic. Natural pigments include clays, gemstones, and minerals, as well as plant and insect materials that make color when powdered. These powdered pigments are mixed with a binder that holds the grains of pigment together and allows the paint to adhere to a surface. Egg yolks, linseed oil, and wax can all be used as binders.

A solvent such as water or oil can be added to change the consistency of the paint or alter its drying time. As with drawing, painters can apply the media to a variety of surfaces such as boards, paper, canvas, and plaster walls. Paint can be applied to a surface with many different tools. We usually think of paintbrushes as the tools used to apply paint, but fingers, sticks, palette knives, and anything else that an artist imagines will make the desired kind of applicator may be used.

One specialized technique of painting that has a long history is the **fresco**. The fresco technique is usually used to paint on walls or ceilings. In creating a fresco, the artist mixes pure powdered pigments with water and applies them to a wet plaster ground. The paint is permanently bound in the plaster, so the artist must plan carefully because he or she will not be able to make changes after the fact. This kind of fresco is termed *buon fresco* ("true" fresco). If an artist uses the technique called *fresco secco*, he or she will apply paints to dry rather than wet plaster. Frescoes have been found in the ruins of Pompeii and in many medieval and Renaissance churches. Diego Rivera,

the famous Mexican muralist of the early twentieth century, used this technique for his murals in Mexico and the United States.

When we think of painting, oil painting usually comes to mind first. Oil paints were not widely used until the 1500s, and prior to that time, tempera was the most commonly used paint. Tempera is a water-based paint. Many of us remember using tempera paint in elementary school. Traditional tempera paint, which uses egg as a binder, has been used by fine artists throughout history. **Tempera** painting requires great skill, and there are limitations to this medium. Tempera colors dry quickly, and so they cannot be blended once they are applied to a surface. Tempera also has a narrow tonal range—colors are either light or dark—and it cannot achieve the close imitation of natural effects that oil paints can. Nonetheless, the positive qualities of tempera are evidenced by the many ancient tempera paintings that still retain their clear and brilliant colors.

Oil paints are much more versatile than tempera paints. Oil paints can be easily mixed, and they may be thinned to build up layers of delicate **glazes**—thin transparent or semi-transparent layers that are applied over another color to alter it slightly. The translucency of glazes permits, for instance, a crimson layer underneath to shine through a yellow layer on top and can thus create brilliant, luminous effects that are impossible to achieve with tempera. Oils can be applied thickly or in heavy lumps to make an **impasto** surface. Since oils dry slowly, it is possible for an artist to work on an oil painting over a long period of time—days or even weeks.

In ancient Egypt, grave markers were painted with wax-based paints called **encaustic**. With encaustic, colored molten wax is fused with the surface via the application of hot irons. The fact that Egyptian markers have survived through the ages indicates the durability of the encaustic medium. Some painters today have returned to this ancient, traditional process.

Gouache is a water-based opaque paint that is similar to school-quality tempera, but of higher quality. Gouache has more body and dries more slowly than watercolor. It is a good medium for creating bright colors and meticulous details and is often used for design and fine artwork.

The most common water-based paint is **watercolor**. Watercolors are transparent, a quality that dictates

the manner in which they are used. The white of the paper upon which the artist paints is a major factor in watercolor. White paint is rarely used in watercolors. Instead, to make tints, the artist adds more water to the paint. The lightest colors are applied first, and then the darker colors, working from background to foreground, from broad areas to areas of detail. Watercolor is not forgiving of mistakes, so watercolor artists must plan carefully and practice diligently.

A recent development in paint is **acrylic paint**. Made from synthetic materials, plastics, and polymers, acrylics were developed after World War II. Acrylics are very versatile. They do not require the slow, careful building up of successive layers with long drying periods in between as do oils. Acrylics are, however, unable to achieve some of the subtleties of which oil paints are capable. For artists who have developed allergies to oil paint and turpentine, acrylics offer a valuable alternative.

Photography

Photography was developed during the mid-nineteenth century, and it soon became a very popular way to document likenesses of people and scenes. The development of photography had a decided impact on other genres of art. As the use of photography grew, painters at first felt pressured to compete with the camera by achieving a higher degree of realism. Ultimately, however, artists felt less of a need to confine themselves to naturalistic styles of painting and were encouraged to explore various forms of art that were entirely beyond the reach of photography. Although not originally considered an art form, photography has gradually assumed a legitimacy within the art world that has only grown in the twentieth and twenty-first centuries. The medium of photography is in constant flux as new technology becomes available. In addition to still photography, film and video art are also used as art forms.

Sculpture

Sculpture is created in four basic ways: carving, modeling, casting, and construction. We usually think of sculpture as being **freestanding**, like the Venus de Milo or Michelangelo's Pieta, but some sculptures are attached to surfaces such as doors, sarcophagi, altars, or church walls. Such **reliefs** may be carved into the stone or wood of the structure itself, or they may be cast of metal and fixed to the surface of the structure. High-

relief sculpture projects significantly from the carrier surface, while low-relief sculpture projects only slightly. Reliefs can only be seen from a limited range, whereas a freestanding sculpture can be seen from every angle.

Carving is a subtractive process in which some of the original material is removed. For example, a stone or wood sculpture can be made by chiseling and gouging away with chisels, hammers, and files to bring the artist's imagined form into physical existence. The scale of carved sculptures can range considerably, from miniature figures that rest on the tip of a finger to monumental forms carved of living rock.

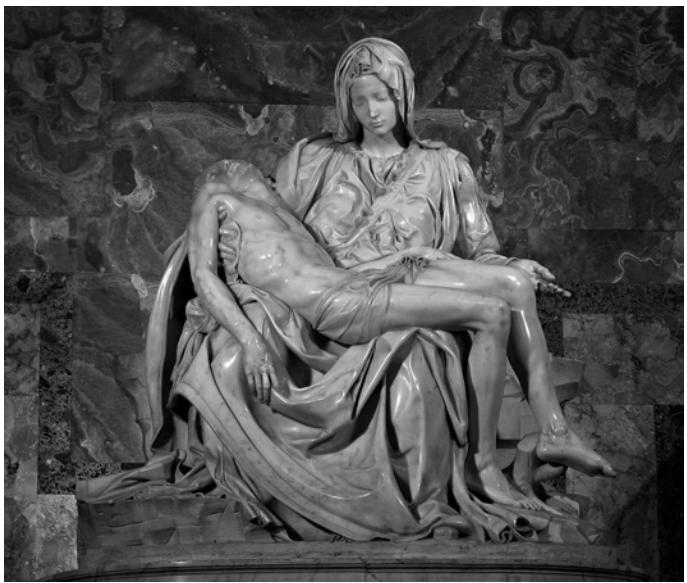
Modeling is an additive process. A soft, workable material like clay, wax, plaster, or papier-mâché is formed by hand. Amounts of these materials can be added to the surface, and the surface can be shaped and decorated by hand or with simple tools.

Sometimes an unfired clay or wax sculpture can become the basis for a **cast form**. In this process, the original form is encased in plaster. When the plaster hardens, it is removed from the original form and retained for use as a mold. The mold can then be filled and thus used to create one or more casts of the original object. Sculptures may be cast in plaster, metal, and more recently, synthetic materials like plastic or polyester resins.

Some sculpture is constructed using a variety of methods. Metal sculpture can be welded from sheet metal or bent from wire. Some artists use paper, board, or wood that is cut and glued, nailed, or joined together by some other means and then possibly painted. Sometimes found objects are combined to create a new sculpture.

Some sculptures can move or can have moving parts. For example, Alexander Calder (1898–1976) created mobiles with forms suspended by wire which can be moved by wind or air currents. Other artists have used a wide variety of motors, pulleys, ropes, pumps, or other mechanical means to introduce movement to their sculptures.

Environmental art, also called **Earthworks** or **Land art**, is a newer category of art form that first emerged in the 1960s, and many works that fit in this category could be classified as sculpture. Environmental art is usually large in scale, is constructed on-site, and is usually not permanent. Environmental art occupies space that



Michelangelo's Pieta is a freestanding sculpture.

may be outside in the natural world or inside a gallery or museum. In either case, the artwork redefines the space in which it is installed. Sometimes, performance may be coupled with the actual installation, and often the viewer is, to some degree, drawn into and involved with the artwork. Often, an essential part of the work of environmental artists is the process of collaborating with the community and governmental agencies to gain approval for their proposed works. Environmental art is often designed to be impermanent or to change over time. Photographs provide us with a more long-lasting documentation of these projects that are often designed to be fleeting in nature.

Mixed Media

Mixed media is the name given to a category of artworks in which the artist uses several art media, sometimes in conjunction with found materials such as fabric, rope, broken dishes, newspaper, or children's toys. Mixed media works can be either two- or three-dimensional. **Collage** is a kind of mixed media in which artists combine various materials such as photographs, unusual papers, theater tickets, and virtually any other materials that can be adhered to a surface. Artists will select materials for their texture, color, or other aesthetic properties or for their symbolic meaning. Pablo Picasso and Georges Braque are credited with introducing this medium to the high-art sphere around 1912.

The artist Robert Rauschenberg (1925–2008) is well known for his mixed media pieces that combine silkscreen images with paint. Some artists create

assemblages using all found objects, both two- and three-dimensional, in their compositions. Joseph Cornell (1903–72) was a twentieth-century artist who filled open boxes with a variety of objects that visually created symbolic and metaphoric statements.

Among traditional and nonwestern cultural groups, masks, ceremonial costumes, and other objects often employ mixed media. Masks may be carved of wood and embellished with grasses, beads, and paint.

Performance

Performance art is art in which the artist engages in some kind of performance, sometimes involving the viewers. Like environmental art, performance art lacks the permanence of more traditional genres of art. Videos or photographs of the performance may be the only remaining documentation of the event. In our world of canned, sterile, and constantly repeated media spectacles, performance art offers a means for recovering unique, unrepeatable human experiences. Since performances cannot be sold as objects, this art form has also been viewed by many as an escape from the increasing commercialization of art. True to the inventiveness of the artistic spirit, artists continue to explore new ideas, new materials, and new processes to express their unique perspectives and ideas. Such creative works continually challenge us to reconsider our own conceptions and definitions of the term “art.”

Craft and Folk Art

Craft, folk art, and popular art are all debated terms applied to a variety of art forms across cultures. In many cases, these terms are used to discuss art forms that are largely utilitarian. Through time and across cultures, people have often sought to make the objects they use more distinctive or beautiful. Consequently, pottery, jewelry, fibers, and glass and wooden objects have come to be recognized as art forms even though they may have a utilitarian purpose. A discussion of craft or folk art raises many questions about the nature of art and the aesthetic pursuit.

Pottery is a medium based upon the use of natural materials. Clay, dug from the ground, is the essential material. Many types of pots can be built using hands and simple tools. A basic pot can be formed from a ball of clay by punching the thumb into the center of the ball and pinching the clay between the thumb and fingers. Clay can also be rolled out into coils with the palm of

the hand, and these coils can then be stacked up to form a clay vessel. Depending on the diameter of the coils, pots built in this way can be of enormous size or made on a tiny, dainty scale. Slab-built pots are made by rolling out clay and cutting carefully measured pieces, which are then assembled by applying liquid clay, called **slip**, to the edges that are to be joined.

The potter's wheel was used in many ancient cultures and continues to be used by artists today. Using the potter's wheel, the potter forms the basic shapes of the pot by manipulating the ball of clay as it turns on the wheel. When a potter uses a potter's wheel to create pots, these pots are described as being "thrown." Throwing allows for particularly thin-walled pots in a wide variety of shapes. Many potters combine hand-built and thrown forms to create beautiful objects that may or may not be functional.

Once the clay form has air-dried, the kiln, a specialized oven, is loaded and fired. In the kiln, all remaining moisture is driven out of the clay, and a chemical change takes place. The pots harden permanently. Then, glazes made of clay and minerals that provide color may be applied to the surface of the pots, and the pots are fired once again. The glazes melt, forming a glassy, waterproof surface on the pots that is both decorative and useful. The surface of a ceramic piece can also be decorated with applied clay designs or with decorations incised or carved into the surface of the piece.

Fiber arts include both woven and nonwoven materials. Weaving has a long history in the production of materials for clothing and other household needs. Some weaving techniques use a loom while others rely on simple braiding, knitting, or crocheting. Quilting is another important craft form that is practiced by popular as well as fine artists.

Archaeological evidence indicates that glass was first made in the Middle East in the third millennium BCE. Glass is most often made of silica, which is derived from sand, flint, or quartz, combined with other raw materials. The introduction of additional minerals adds color. The development of glassblowing enabled the formation of glass vessels such as vases, drinking glasses, and perfume bottles. Stained glass became a dominant art form in the medieval period and was used to create the dramatic windows of cathedrals. By the end of the nineteenth century, stained glass had also become popular for lampshades and windows in

residential homes.

Wood has been used to make functional objects such as furniture, boxes, boats, and homes. Northwest Coast Indians carve boxes and house boards with traditional designs. People all over the world have made wooden boats in varying practical and aesthetic forms. Today, artists make all kinds of objects from wood. Such objects may be functional, but first and foremost, they aim to be aesthetically pleasing. Functional objects like tables and chairs assume the status of art when the design is unique, the craftsmanship superb, and the visual effect beautiful. Sometimes these objects may no longer be functional, but become art for art's sake.

Architecture

Architecture is the art and science of designing and constructing buildings. People in every culture and geographic area have designed shelters that meet their needs for protection. As people have imagined structures for a variety of communal and personal uses, they have developed various methods of construction to realize their ideas. Specialists in designing structures have become known as architects.

In early times, materials that could be found locally were used for building. Sticks, mud, grass, animal skins, ice, and wood were used in different climatic areas. Later, brick and stone were also used. An important architectural development was the use of the **post-and-lintel construction** technique in which a long stone or wooden beam is placed horizontally across upright posts. The famous Greek [Parthenon](#) is an example of post-and-lintel construction. This method is still commonly used today, with steel and wood being the favored materials.

Other key developments in architecture include the arch, the vault, and the dome. Each of these is a variation of the same concept that allowed for greater height and more interior open space inside a building. The Romans were great engineers, and the [Colosseum](#) in Rome provides a fine example of vaulted construction. The Romans developed concrete as a building material, which they used in building aqueducts, great baths, and other public works projects.

In the medieval period, a skeletal building style developed that alternated between strong buttresses and thin walls with stained-glass windows, which admitted more light and color into the building. Many



Flying buttresses at Bath Abbey, Bath, England.

medieval cathedrals provide classic examples of this method. The addition of flying buttresses—external arches that counterbalanced the outward thrust of the high, vaulted ceilings—allowed for even more height and window openings.

During the Industrial Revolution, many new materials and processes for building were developed. In 1851 the [Crystal Palace](#), so named because it consisted mainly of glass walls that were held in place by a framework of slim, iron rods, was built for the world's fair in London. The [Eiffel Tower](#) in Paris, an amazing and beautiful monument, is primarily a framework of wrought iron.

[Antoni Gaudí](#) (1852–1926) created ingenious buildings of cut stone in Spain in the late 1800s and early 1900s. Without any flat surfaces or straight lines, Gaudí's buildings are very organic in appearance. While we usually think of buildings as being more modular, having a regular and geometric shape, many architects have challenged this notion and have searched for aesthetically interesting designs and new materials to

move beyond the idea of a building as merely being a box-shaped construction.

Steel and concrete have become the favored materials for large public, commercial, and multi-family housing while wood and brick continue to be commonly used for residential homes. While many buildings are designed by builders using more standardized plans, leading architects continue to explore new and exciting designs and materials.

SECTION I SUMMARY

- Art history is an academic discipline that seeks to reconstruct the social, cultural, and economic contexts in which an artwork was created. The basic goal of this work is to arrive at an understanding of art and its meaning in its original historical context. Art historians rely on a variety of documents and sources in order to conduct formal and contextual analyses.
- The history of Western art is often studied

chronologically. This study begins with early cave paintings in southeastern France and takes us to contemporary art all over the world.

- Early civilizations arose in Mesopotamia. Other ancient Western cultures important for their art traditions include Egypt and Nubia, and the civilizations of the Aegean Islands, Greece, and Rome. The artworks that have survived from ancient civilizations are those made of durable materials. Often these artworks were preserved in places that were relatively inaccessible.
- Tremendous shifts occurred in the art of the medieval period with the emergence of Christianity as a major religion and the Church as a powerful patron of the arts.
- The Church remained an important patron of art during the Renaissance and Baroque periods; at the same time, there was also a rise in secular artworks during these periods, in light of the Protestant Reformation and general societal and economic shifts throughout Europe.
- Major innovations of the Renaissance include the use of linear perspective and a move toward greater naturalism. Baroque art is generally distinct from Renaissance art because of its greater sense of movement and drama.
- The Rococo style of art was closely tied to the power of the French aristocracy prior to the Revolution of 1789. The Neoclassical movement may in part be seen as a reaction to the Rococo and a response to the political and social revolution. Romanticism, in turn, was a reaction to the classicizing tendencies of Neoclassical art. Romanticism sought to appeal to the emotions and the senses.
- Realism and Impressionism both emerged in the second half of the nineteenth century. Both movements were focused on everyday life as a subject matter, although Impressionism became increasingly concerned with ideas of visual perception.
- Other late nineteenth-century developments included Post-Impressionism and the Pre-Raphaelites.
- Modernism emerged in the early twentieth century. Important modernist movements

include Cubism, Expressionism, Dada, Surrealism, and Abstract Expressionism.

- The Armory Show in New York (1913) marked a shift in the art world, as the United States became a new center of progressive artistic activity.
- Pop Art, Minimalism, and Photorealism responded to a post-WWII industrial culture. Installations, performance, and Environmental art (also known as Land art or Earthworks) all sought to challenge conventional ideas of art and its limitations.
- In the past, areas of nonwestern art were not incorporated in the chronological study of Western art; distinct regions of the world have often been studied separately. Today, though, many art historians are challenging this based on the realization that art throughout the world is interconnected, especially in terms of contemporary art. Art historians sometimes rely on different methods to understand nonwestern art.
- China, India, and Japan are among the major cultures of Asia. All three countries have ancient traditions and have produced art that relates to political power and religious practice.
- Ancient traditions can also be found in Africa. Often the arts of Africa and Oceania were created for very different functions from art in the Western traditions; consequently, there are tremendous formal differences as well.
- Islam is a major world religion that has produced much art. Most Islamic art is non-figurative.
- Ancient civilizations existed in the Americas as well. Archaeology is often used to learn about these civilizations and their art.
- In addition to understanding context, art historians seek to describe the formal qualities of artworks. Important terms used to discuss the formal qualities of an artwork include: line, shape and form, perspective, color, texture, and composition.
- Artists throughout time have worked in a variety of media, including drawing, printmaking, painting, photography, sculpture, mixed media, performance, craft and folk art, and architecture.

SECTION II

Premodern Advances in Technology

Across Europe, Asia, and Northern Africa in the early modern era, technological advances helped determine the shape and color of human cultures. Pigments harvested from the earth were used to color glass, ceramics, and paints that were used in rituals ranging from the religious to the political. Technological developments like concrete and flying buttresses advanced architectural projects that led, in turn, to artistic advances in decoration. In China, advances in kiln technology allowed worked clay to be fired at high temperatures to produce porcelain, which quickly developed into a prized art. In Northern Africa, incredibly advanced practices in mummification were based on scientific and biological learnings, supporting religious belief systems.

CONCRETE IN ANCIENT ROME

Today, when we think about the Roman Empire, we conjure up images of its architectural structures: the perfectly elliptical [Colosseum](#), the Roman [Forum](#)'s evocative ruins, or the triumphal arches of [Titus](#) and [Septimius Severus](#). These structures exist today because of what is likely the Romans' most significant technological innovation: concrete.

From the sidewalks we walk down to the roads we drive on and the homes we live in, our contemporary world is defined by concrete—so much so that it is difficult to imagine life without it. While modern concrete differs significantly from Roman concrete, or *opus caementicium* as the Romans called it, the basic elements are still the same: broken stone, sand, lime mortar, and water.

It is in part because of this most essential building material that the Roman Empire was able to achieve such widespread dominance. Upon the death of the emperor Trajan in 117 CE, Rome was the capital of a government that ruled territories on three continents. At its height, the Roman Empire ruled nearly all of

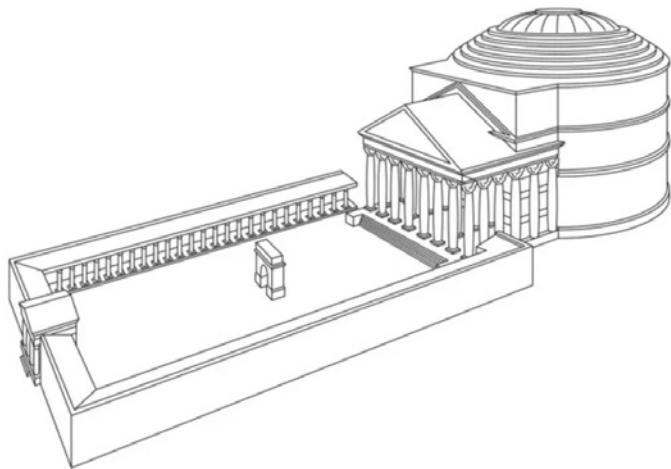


Ancient Roman concrete consists of chunks of volcanic tuff and brick bound together by a volcanic ash-lime mortar.

Image: Roy Kaltschmidt, Berkeley Lab

Europe, North Africa, and West Asia. Everywhere they governed, the Romans deployed art and constructed monumental public architecture as political tools to glorify emperors and advance political agendas. To accommodate their expanding territory and growing population, the Romans carried out extensive building programs. Roads, bridges, and aqueducts facilitated travel, trade, and communication between the far-flung regions of the Empire. Had the Romans been satisfied with the same building materials used by the Greeks and Etruscans who came before them, our world today would likely look very different.

Although the Romans were not the first to create concrete—it was invented in the ancient Near East—they were the first to utilize the material on such a widespread scale. Roman builders mixed concrete according to a changing recipe, poured it into wood frames, and left it to harden. When the concrete dried, the wood molds were removed to reveal a remarkably strong mass. The exterior-facing sides of these coarse



Schematic drawing of the Pantheon complex in ancient Rome.

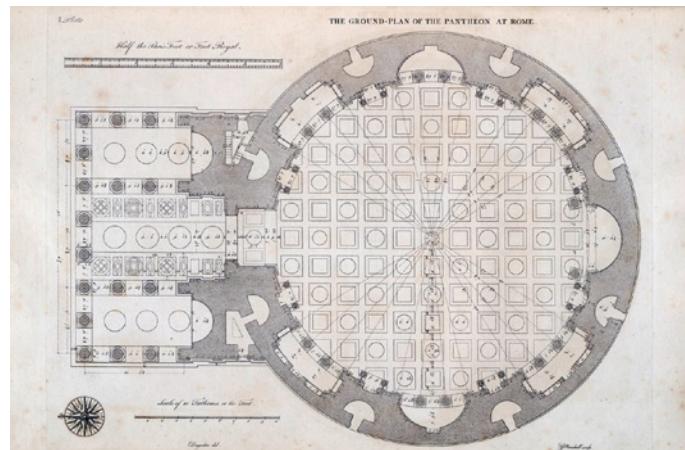
surfaces were then often covered in stucco or marble **revetment** (facing).

The Concrete Revolution

The development of concrete was a catalyst for dramatic changes in Roman architecture. Early on in the Roman Empire's history, builders used concrete as a filler material between walls. But after adding *pozzolana* sand to mortar, architects discovered a material of enhanced and remarkable durability that could even cure, or set, under water. They increasingly used the material from the second century CE onward.

These builders were quick to recognize concrete's many advantages. It was incredibly strong and durable, as well as relatively inexpensive and convenient to mix on site during construction. It could also be worked by unskilled laborers; and it was incredibly adaptable. By constructing wooden frames into which liquid concrete was poured, builders could mold the fluid, wet material into forms that would harden into shapes that were otherwise impossible to make with cut stone, wood, or mud brick. By allowing new shapes at expanded scales to be incorporated into building plans, concrete revolutionized Roman architecture and, by extension, the contours of human civilization. From war to worship and from governmental operations to public performances, concrete shaped the limits and thus the habits of life.

Just as the Romans recognized and mechanized the potential of concrete, they also developed the arch, the vault, and the dome—which had been used previously in the ancient Near East and Etruria, but to a lesser extent. These basic architectural forms could be



The Pantheon ground plan.

combined and recombined in any number of ways. Using concrete, the Romans made buildings of great stability, durability, and flexibility, a true departure from the buildings of the past.

For example, pre-Roman builders had constructed barrel vaults using traditional **ashlar masonry** (cut-stone construction), but those earlier vaults were less stable than concrete barrel vaults. As with arches, if even a single block of cut-stone vault were to come loose, the whole vault could collapse. Moreover, masonry-vault buildings were perpetually dark and shadowed because they could be illuminated only by light entering at either end of the vault's tunnel. By using concrete, Roman builders were able to place windows at any point along the vault, thus allowing for much better lighting. Once the concrete hardened, the structural integrity of the vault was not impacted by any openings within it. Concrete vaults were also relatively fireproof, giving them a major advantage over timbered vaults—fire has been a common occurrence and major concern throughout the history of human civilization.

For an environment as prone to earthquakes as the Italian peninsula, the internal constructions within walls and domes that came with concrete construction created stabilizing layers within the building's larger mass. These layers enabled the concrete portions of buildings to shift slightly with the movements of the earth, making brick-and-concrete constructions more flexible and thus more stable. Although extant buildings from ancient Rome have sustained serious wear, many still stand today—an incredible feat for structures more than two thousand years old.²

SELECTED WORK: The Pantheon, Rome, 126–128 CE

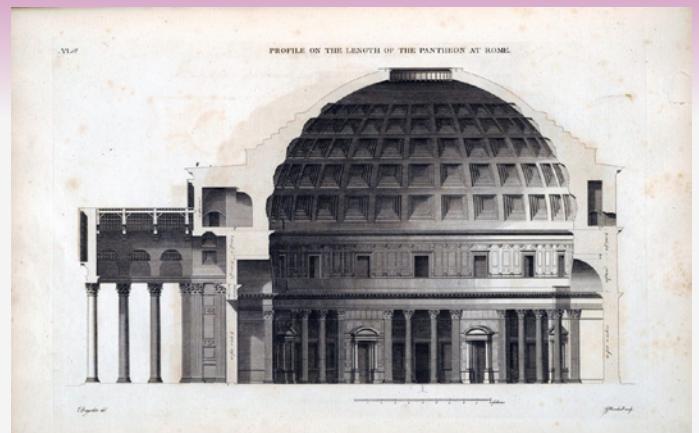
Of all the concrete structures built by Roman architects, the Pantheon is one of the most technically advanced. Built as a temple, the circular building was constructed for religious worship during the reign of Emperor Hadrian and dedicated to the five planetary gods known in the second century—Jupiter, Mars, Mercury, Saturn, and Venus. Thus, based on a Hellenistic concept, the Pantheon was intended to function as a temple to all the gods. (Its name is derived from the Greek words *pan*, meaning “all,” and *theos*, meaning “gods.”) Because it was converted into a church in the early seventh century, the Pantheon exists today as one of the best-preserved temples from ancient Rome.

In its day, the Pantheon’s dome was an engineering marvel. It would remain the largest dome in the world until the sixteenth century. Today, it is the world’s largest unreinforced concrete dome. The experimental architectural form was the extraordinary result of an increased confidence in the strength and pliability of concrete. Roman builders and engineers were faced with many structural challenges while constructing the Pantheon, and their solutions were often dependent upon the manipulation of concrete’s material permutations.

They built, for instance, a cylindrical drum layer-by-layer using concrete of varied compositions. Heavy basalt and travertine stone went into the mixture for the bottommost foundations, followed by tufa and brick. These aggregate materials became progressively lighter as the structure rose until, at the top, featherweight pumice replaced solid stones within the concrete. The thickness of the dome’s walls also decreases as they near, at the very top of the dome, the **oculus**—the circular opening twenty-seven feet in diameter that is the only light source for the interior space. (*Oculus* means “eye” in Latin.) The use of **coffers**, the square sunken decorative panels on the dome, also lessens the dome’s weight without corrupting its structural integrity.³

In Roman times, the Pantheon stood at the south end of a long rectangular court. Visitors to the temple would enter at the opposite end of the space, moving first through the tight confines of a narrow **colonnaded** entry before stepping through to the wide-open space of the court to see the Pantheon framed on the opposite end by the court’s remaining three sides of continuous **porticoes**. These porticoes extended on the south up to the sides of the temple’s pedimented porch, hiding the temple’s circular drum from view. A visitor approaching the temple’s broad octastyle façade would have been awed by the forest of enormous gray and pink granite columns soaring upward. But in every other way, the temple front would have been unremarkable and even common in its architectural plan, a copy of the then-standard Greek temple.

But a dramatic surprise was in store in ancient times as well as today. Stepping through the shaded portico and across the threshold, the visitor enters the vast and shadowy circular hall of the **rotunda**, its curved walls punctuated by seven large niches at ground level. Each of these seven niches was once marked for a different deity, with Corinthian columns supporting alternating triangular and rounded **pediments**. Colored slabs of marble still decorate the interior surfaces of the walls; the floor, as well, consists of patterns of circles and squares in colored stone. High above soars an enormous dome, pierced at its zenith with an oculus open to the sky. If it is a sunny day, light passes through the oculus in a circular beam and falls on the dome’s coffered ceiling. This disk of light moves across the coffered dome over the course of the day as the sun moves across the sky. For the visitor in ancient Rome, this illuminated circle would have symbolized the eye of Jupiter, the supreme celestial deity ruling over Roman peoples.



An elevation drawing of the Pantheon.

The sphere of the Pantheon's magisterial dome measures precisely the same in height and diameter and is based on the intersection of two circles, one horizontal and one vertical. For the ancient Roman, the dome and oculus with their perfect spherical shapes symbolized eternity and perfection, a reflection of the heavens the space was made to honor. Even the dome's coffers reflected these messages: the recessed squares would have been painted deep blue and decorated with bronze rosettes, evoking the image of stars strewn across the night sky and underlining its emulation of the dome of heaven.

All this emphasis on circular shapes means there is a notable absence of vertical sight lines connecting the Pantheon's floor to the upper recesses of its dome. The visual experience for the viewer, then, is of a colorful floating dome. As the scholar of Roman art Penelope J. E. Davies has said of the dome, "The optical effect is that it hovers unfettered above the visitor—who feels, paradoxically, both sheltered and exposed. The dome seems to be in perpetual motion, spinning overhead in the same way as the heavens it imitates."⁴

Since the building and its larger complex perform such feats of physical and visual manipulation, it comes as no surprise that, upon completion, the Pantheon became emperor Hadrian's favorite place to hold court. Hadrian took advantage of the temple's authoritative connection to the heavens as a way to reinforce his own position of power over foreign emissaries, politicians, and everyday citizens. These visitors, already in awe of the building inside of which they stood, could have been easily manipulated indeed.



Giovanni Paolo Panini, Interior of the Pantheon, Rome. c. 1734, oil on canvas, 128 x 99 cm.

National Gallery of Art

THE ART OF MEMORIALIZATION IN ANCIENT EGYPT

Ancient Egyptians believed that death was only the beginning of their journey into eternal life. To ensure the safe passage into the Kingdom of Osiris (the land of the dead), the deceased had to be physically preserved along with their earthly possessions. Much of the art and architecture that survives from ancient Egypt is thus funerary in nature. These odes memorializing the dead have been preserved in northern Africa's dry desert climate for thousands of years.

Mummification—the embalming and wrapping of the human body for preservation—is one key example

of the ancient Egyptian belief system, a practice that highlights their preoccupation with continued material existence in the afterlife. As the technological processes of mummification developed, more and more elaborately decorated coffins (called sarcophagi) were built to house the embalmed bodies of the dead. In case the physical body did not last, a portrait would be buried with the body to serve as a substitute. The portrait was believed to function as a container that could preserve the dead's *ka*, or soul, which was believed to enter the surrogate of the portrait before journeying to the next world.

The seventy-two-day process of embalming corpses began with the removal of internal organs that might

rapidly decay, except for the heart, which was believed to be the seat of understanding and was therefore left intact. The body was then packed in dry natron—a natural compound of sodium carbonate and sodium bicarbonate found in Egypt—which dehydrated the cadaver and dissolved its body fats. Then the corpse was washed, treated with oils and ointments, and wrapped with up to twenty layers of linen. To make the mummy seem even more life-like, sunken areas of the body were filled out with linen and other materials, and false eyes were added. The organs were embalmed, with the stomach, liver, lungs, and intestines placed in special boxes or jars that are today called canopic jars. These were buried with the mummy. The Egyptians' advanced technological processes of embalming were so successful that we can view the mummified body of an Egyptian today and have a good idea of what they looked like in life some three thousand years ago.



British archaeologist Howard Carter examines the innermost coffin of Tutankhamun. As the technological processes of mummification developed, more and more elaborately decorated coffins were built to house the embalmed bodies of the dead.

SELECTED WORK: Mummy with an Inserted Panel Portrait of a Youth, Egypt, Roman Period, 80–100 CE

Following the Roman conquest and colonization of Egypt, which began in 30 BCE, the Egyptians continued to bury their dead in mummy cases, but they replaced traditional stylized masks with painted portraits in a more naturalistic style. These portraits were painted in encaustic, a technique wherein an artist mixed colored pigments with wax (usually beeswax) and then applied the material to a smooth surface. The best evidence for this technique comes from the region of Fayum (variably spelled Faiyum), where mummified bodies routinely incorporated encaustic portraits on wood panels. Today hundreds of these Fayum portraits are preserved in museum collections around the world. Stylistically, they represent a sea change in the art of ancient Egypt. At the time, Roman portrait traditions prioritizing realism and lifelikeness were overtaking older forms of stylized representation. The result was a hybrid art form that represented the multicultural and multiethnic society of Roman Egypt.

Fayum portraits are striking works conveying the palpable psychology of their sitters. In the words of the art historian John Berger, Fayum portraits “are the earliest painted portraits that have survived; they were painted whilst the Gospels of the New Testament were being written. Why then do they strike us today as being so immediate? [...] Why do they] touch us, as if they had been painted last month?”⁵

Usually painted directly from life, the encaustic panels (frequently on linden wood) were only later cut down to fit atop the mummified body following the sitter’s death. As such they are incredibly immediate and eerily real portraits of a professional urban middle class—teachers, soldiers, athletes, Serapis priests, merchants, and florists. Occasionally their names have come down to us as well—Aline, Flavian, Isarous, Claudine, and many more.⁶ In *Portrait of a Young Woman in Red*, the background of the panel would have been gilded with sparkling gold foil, suggesting the illusion of pulsating life. With her long lashes framing eyes that twinkle with white highlights, she seems to stare into the future—into the eternal life in which Egyptians believed.

Mummy with an Inserted Panel Portrait of a Youth, one of our selected works, is a rare example of a Fayum portrait that remains intact on the mummy case it was made to adorn. It is a portrait of the living human whose remains are now housed within. Presently on view in the Egyptian galleries of the Metropolitan

Museum of Art in New York, the portrait depicts a youth with large glittering eyes. The soft shadow of a downy moustache on his upper lip suggests his youth. In Roman Egypt, the emerging moustache was an indicator of the young man's coming of age into important social groups as well as evidence that he was in the prime of his sexual attractiveness and vigor.

Fayum panel portraits like this one can be understood as serving a double pictorial function. They were identifying pictures, made to distinguish the dead on their journey with Anubis, the death god, to the Kingdom of Osiris. Secondly, they served as mementoes of the departed for the grieving family. Because the embalming of the body took seventy-two days, the panel portrait would hang in the home until it could be adhered to the prepared mummy. Even after this final step in the preparation of the body for the afterlife, the mummy could be kept in the home for a period of time, leaning against a wall, still a member of the family circle before finally being interred in the necropolis.

To produce a mummy portrait in encaustic, the first step was to sketch the outlines of the face and garment on a wood panel prepared with a special transparent glue or dark wax. Then a mixture of beeswax and powdered pigments, called encaustic, was applied. In a liquid state, the wax was laid on quickly with a paint brush, employing a thinner mixture for the background and garments and thick, creamy, paste-like paints for the facial features.

The Fayum portraits are essentially a hybrid art form, blending Roman and Egyptian visual traditions. The immediacy of Fayum mummy portraits—with luminous eyes that gaze intently out of faces modeled with highlights and shadow, ornamented with glittering gold leaf—contrasts sharply with the cool precision of most pharaonic images. And yet, while the painting techniques that produced Fayum portrait panels were Greco-Roman in origin, their use in adorning mummies was completely Egyptian.

Because Fayum portraits emerged from this period of deep uncertainty, artists wanted to capture their sitters with a vibrant, certain presence. Ruled for three hundred years by a Greek (Macedonian) dynasty followed by more than a century under Roman rule, Roman Egypt was an extremely diverse civilization. The population consisted of Roman citizens and citizens of Greek cities such as Alexandria (made up of many different ethnicities) as well as native Egyptians. The subjects of the mummy portraits clearly were dressed and coiffed like Romans, and many of them bore Greek names or names that were Greek versions of Egyptian names. However, they and their families found consolation in ancient Egyptian beliefs about the afterlife.



Portrait of a Young Woman in Red, c. 90–120 CE, encaustic, limewood, gold leaf on panel.

The Metropolitan Museum of Art



Architectural historians generally agree that the post-1194 Chartres Cathedral was the first High Gothic building.



Flying buttresses were integral to the construction of Chartres Cathedral.

STAINED GLASS IN GOTHIC ARCHITECTURE

Gothic architecture is one of the towering achievements in the history of world architecture. It was the unique product of an era of peace and widespread economic prosperity, deep spirituality, and extraordinary technological innovation. Developed in the region around Paris called the Île-de-France, the Gothic style quickly came to be called *opus francigenum* (“French work”) or *opus modernum* (“modern work”). Gothic cathedrals were viewed as stone and glass images of heaven: the very Cities of God. These artistic developments paralleled political ones, as princes and kings were aided by technological advances, including cannon and iron crossbow design, and were thus able to conquer increasingly large territories administered by vassals, who in turn collected taxes to support armies and navies.

Emerging from the standards of Romanesque art, the Gothic style was prevalent in Europe during the High and Late Middle Ages (from the late twelfth to the sixteenth century). The word “Gothic” was developed by the Renaissance-era artist and biographer Giorgio Vasari, who used the term for the first time in his 1550 *Introduction to the Three Arts of Design*. Gothic architecture primarily diverges from Romanesque in the shape of its arches: whereas Romanesque architecture used the Roman-style curved arch, Gothic architects developed pointed arches in their vault designs.

A major advantage of Gothic architecture is that pointed arches channel the weight of soaring vaults

more directly downward compared to semicircular arches, meaning the vaults require less buttressing to hold them in place. With less downward force pressing on the walls, stonemasons were able to create thinner walls with more and larger window openings, creating buildings with enhanced interior illumination. Because pointed arches visually guide the eye upward, they also make the vaults appear taller, creating the illusion of soaring ceilings stretching up to heaven.⁷

The Cathedral of Notre-Dame in Paris is a landmark in the history of architecture. It was there that an anonymous architect worked out for the first time the engineering solution that made possible the mature High Gothic style: the **flying buttress**. To hold the cathedral’s much thinner and taller walls in place, the builders used external flying buttresses in combination with rib vaults and pointed arches. Because the downward thrust of the walls was now supported externally by flying buttresses, it enabled builders to open up the walls to enormous windows of stained glass.

Though not a Gothic invention, stained glass windows were such an integral part of Gothic architecture that they are essentially synonymous with it. No other period produced windows of such radiant color and luminous beauty. The monk Theophilus Presbyter’s twelfth-century handbook *De diversis artibus* described in great detail the technique for making stained glass.⁸ It required a molten mixture of silica (basically sand), potash (to lower the temperature at which silica melts), and lime (a stabilizer), plus the addition of metal oxides to color or “stain” the glass. For example, the addition of cobalt oxide produced blue glass, while copper oxide made red glass, and

manganese oxide purple. The glassworker heated the mixture in a wood-fired furnace and either poured it into molds to cool or shaped it by blowing air through a tube to form the soft glass mixture into an oval ball or cylinder, which was then cut open and flattened.

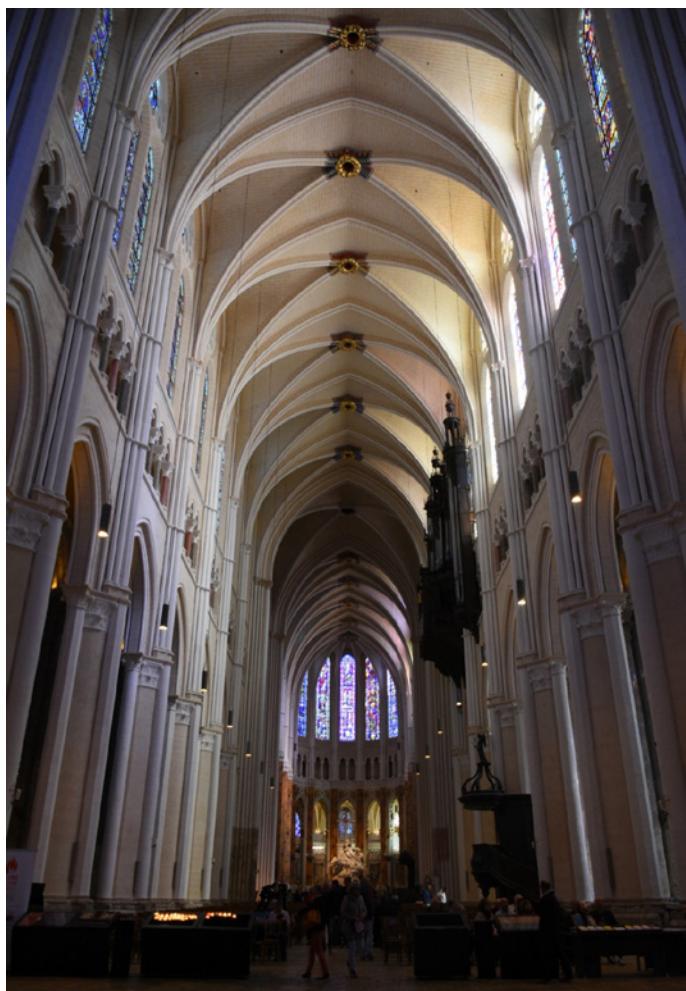
The manufacture of a stained-glass window was costly and labor-intensive, requiring significant expertise and a hierarchical division of labor. First, the master designer drew the exact composition of the planned window on a wood panel. Glassblowers then provided flat sheets of glass of different colors to **glaziers** (glassworkers), who were responsible for cutting the windowpanes to the required size and shape using specially designed iron shears. Glaziers produced an even greater range of colors by **flashing** (fusing one layer of colored glass onto another). Next, painters added details such as faces, hands, hair, and clothing in enamel by tracing the master design on the wood panel through the colored glass. Then they heated the painted glass to fuse the enamel to the surface. Afterward, the glaziers “leaded” the various fragments of glass, a process of joining that was accomplished by melting strips of lead together and then reinforcing the completed window with a web of iron.

Lux Nova

By the twelfth century in Europe, stained glass was both a refined art form and a religious phenomenon. Not only did its brilliant properties create a divine experience for churchgoers, but it also provided a platform for Christian imagery.

In fact, it was the Christian church that first exploited the symbolic significance of the medium. In the book of Genesis, God’s first words are “Let there be light” (Genesis 1:3). Later, Christ would describe himself as “the Light of the World” (John 8:12). For the medieval viewer, the connection between glass and light was enigmatic and malleable. St. Bernard of Clairvaux, for example, highlighted the miraculous splendor of the sun passing as if by magic through transparent glass. He compared this phenomenon with the unsullied virginity of the Virgin Mary penetrated by the Holy Spirit.

Not simply decorative, the colored light produced by stained glass was meant to convey and heighten a sense of the divine pouring in from above. **Abbot Suger**—the influential church official, statesman, and historian—called this colored light *lux nova*. Latin for “new light,” Suger used the phrase to describe the heavenly aura

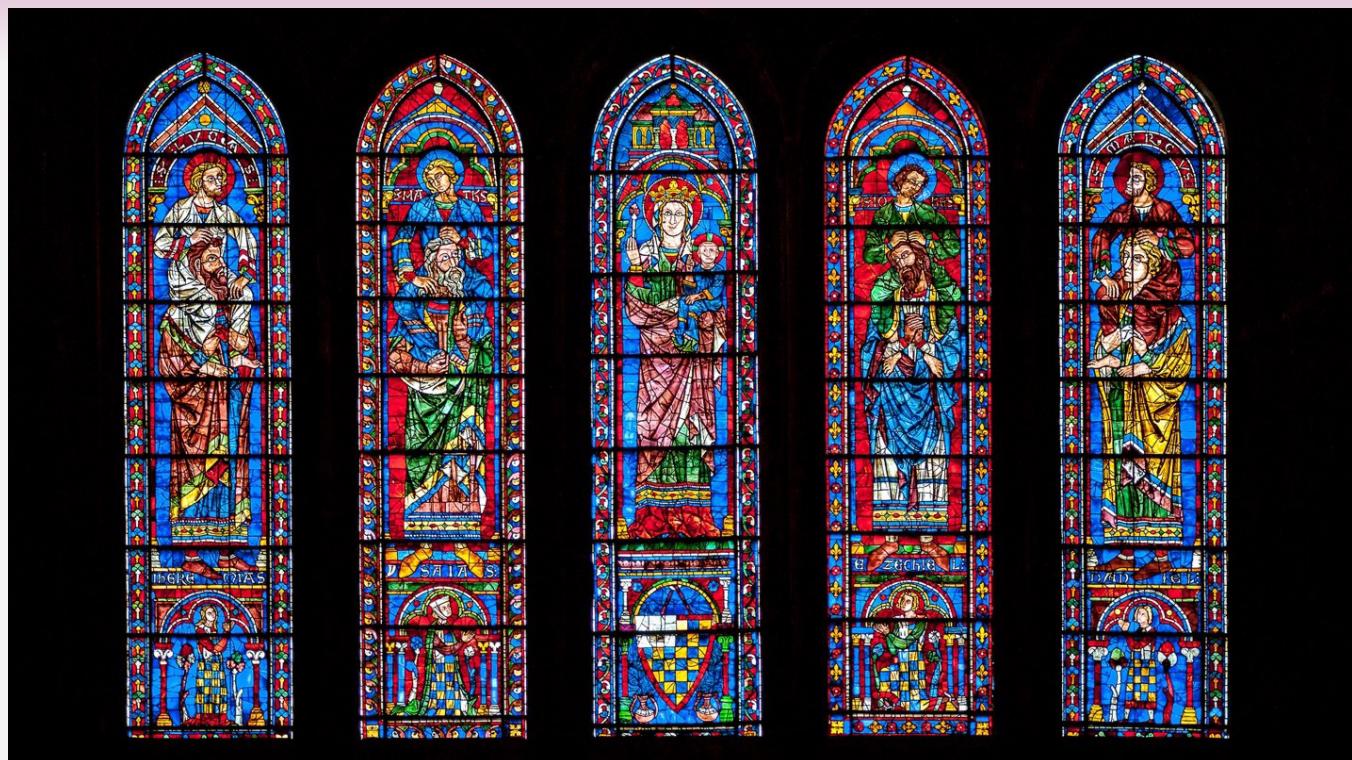


The nave of Chartres Cathedral.

of celestial radiance born from the colored light. A prominent Parisian theologian, Hugh of Saint-Victor, likewise prioritized the mystical qualities of stained-glass windows, writing, “Stained-glass windows are the Holy Scriptures...and since their brilliance lets the splendor of the True Light pass into the church, they enlighten those inside.”⁹ William Durandus, bishop of Mende in southern France, similarly declared that “[t]he glass windows in a church are Holy Scriptures, which expel the wind and the rain, that is, all things hurtful, but transmit the light of the True Sun, that is, God, into the hearts of the faithful.”¹⁰

Enhanced by the daylight that passes through it, stained glass changes with the weather, the season, and the time of day. When a panel of glass is shot through with a strong ray of light, you can see the colors floating off the top of the panel. The effect of multicolored refracted light playing off surfaces and across spaces transforms Gothic buildings, infusing them with the otherworldly aura of the divine.

SELECTED WORK: South Rose Window of Chartres Cathedral, France, 1221–30



Detail, lancets below the South Rose Window at Chartres Cathedral with donor portraits along the bottom.

In 876, the church at Chartres in northern France—officially the Cathédrale Notre-Dame de Chartres, devoted to “our lady of Chartres”—acquired the veil believed to have been worn by Mary when she gave birth to Christ. When a fire destroyed the church a few centuries later in 1194, officials interpreted the holy relic’s survival as a sign that Mary wanted a new church.

The Chartres Cathedral we see today was constructed in an astonishingly short seventy years, providing a unique snapshot into the styles and iconographic programs of what most architectural historians consider the first High Gothic building. (Most other Gothic cathedrals, like Paris’ Notre-Dame, took centuries to build.) The cathedral contains the world’s largest surviving collection of medieval stained glass, with more than 180 thirteenth-century windows. They cover nearly twenty-eight thousand square feet in total and consist of 172 bays illustrating biblical scenes, the lives of the saints, and scenes from the life of trade guilds of the period. In the Gothic period, the mystical jewel-toned light pouring through these windows would have encouraged meditation and prayer. While churchgoers were mostly illiterate, they were fluent in understanding the rich symbolism depicted in the windows. Visually reading the full story of Christianity in the church’s windows and sculptures could offer them hope and purpose beyond the struggles of their daily lives.

At Chartres, glaziers carefully planned entire iconographic programs for stained glass cycles relating stories from the Old and New Testaments. They considered a whole host of details from the orientation of the windows relative to the viewer, to the degree of relative sunlight passing through the windows during the day. For example, blue glass dominates the rose window in the north transept, which tells the darker and more foreboding stories of the Old Testament. In the rose window set into the south transept, representing stories from the New Testament, red dominates. This layout was planned strategically, as the red glass admits

less sunlight from the more intense southern exposure, balancing the amount of natural light entering the building.

Rose windows are decorated circular windows favored by architects during the High Gothic period. The rich decorative motif is formed from a window divided into segments by stone mullions and tracery. The general scheme of a rose window's tracery consists of a series of radiating forms, each of which was tipped by a pointed arch at the outside of the circle. The bars between these forms were joined at the center by a pierced circle of stone. Symbolically, the rose window represents the coming together of many parts to make a balanced whole, the circular shape evoking perfection and eternity.

The theme of the south rose window at Chartres is the Glorification of Christ. At the very center of the circular window is the seated figure of Christ, his right hand raised in a gesture of blessing. Moving outward from the center, Christ is encircled by angels in the first ring of wedge-shaped windows and, beyond, by the twenty-four Elders of the Apocalypse in the outer bands of circular and half-circle windows. Each elder wears a crown and holds a vial of perfume and a musical instrument. Evoking the sounds (music) and the scents (perfume) of the Apocalypse—the complete final destruction of the world foretold in the book of Revelation—this colorful vision gestures to an all-encompassing sensory experience, one existing beyond the boundaries of the visual and pictorial.

With a diameter measuring in at a staggering thirty-four feet, the rose window's symbolism emphasizes Christ's supernatural being in its role as truth-teller; here Christ reveals the future of the world and all its cosmic mysteries. With its spherical design evoking the spinning wheel, the window reads like a dream vision of the future end of the world where Christ reigns supreme at the heart of heaven.

Below the circular south rose window are five **lancet windows** (slender, pointed windows) with New Testament figures sitting on the shoulders of Old Testament figures. The central one shows Mary holding the Christ Child. The other four lancets show Old Testament figures, which are, from left to right: Jeremiah carrying Luke, Isaiah carrying Matthew, Ezekiel carrying John, and Daniel carrying Mark.¹¹

Finally, in the lowest register of these lancet windows are panels with portraits of the donors. The south rose window at Chartres was financed by the Dreux Bretagne family, specifically Count Pierre Mauclerc and his wife Alix de Bretagne. The blue and yellow checked arms of Dreux and Brittany—the home province of the donors—are represented in the central bottom panel as well as the quatrefoil panels in the outer ring of the rose window. In the Gothic age, donors, whether wealthy individuals, churchmen, nobles, religious fraternities, or commercial corporations, exerted the greatest influence on the content and appearance of a window. This relationship began at the very start of the design process with the sketch design, a certified drawing that formed part of the contract between donor and craftsman.

The monumental rose window at Chartres transforms daylight into illumination, embodying the poetic and symbolic values so prized by Abbot Suger. The sensation of ethereal light dissolves the physical solidity of the church, deliberately blurring the distinction between the temporal/earthly realm and that of the eternal/divine. This miraculous *lux nova* shapes the intensely mystical experience that lies at the heart of the Gothic religiosity.



Detail, Christ's Blessing, South Rose Window.



Dragon kiln of Jiaotanxia, now Southern Song Imperial Kiln Museum in Hangzhou, China. The kiln is about 131 feet long by 6.56 feet wide. It was originally covered, like all kilns, to retain the heat.



Raw kaolin clay from China.

CHINESE CERAMICS AND THE KILN

In the premodern period, ceramics represented cutting-edge material science, and Asian cultures were the global leaders in this advantageous, practical, and beautiful technology. Chinese ceramics, by far the most advanced in the world, were made of naturally occurring clay dug from the earth and distributed to the imperial court and the domestic market or exported.

By 200 CE (during the Han period), Chinese artisans had developed massive **dragon kilns** (named for their long and thin shape) containing multiple chambers. These kilns produced the world's first **porcelain** objects and made China the global epicenter for ceramic production.

The Chinese use the word “ci” to connote either porcelain or stoneware—it does not distinguish between the two. But in the West, porcelain refers to high-fired (about 1300°F) white ceramics, with translucent bodies that make a ringing sound when struck. Stoneware is a tougher, non-translucent material, fired to a lower temperature (1100–1250°F). Whereas ceramics are generally viewed as elegant, delicate, and ethereal, stoneware is thought to be thick, tough, earthy, and utilitarian.

Blue-and-White Porcelain

Millennia of innovations in ceramic technology laid the groundwork for the blue-and-white glazed porcelain developed in the fourteenth century (called

青花 in Chinese, which means “blue flowers”). It utilized the **underglaze painting** process, new in the Yuan period (1279–1368). In underglaze painting, cobalt-blue pigment was painted onto an unfired porcelain surface. Then, a thick clear glaze was applied over the cobalt design, and the vessel was fired. The result was a delicate, shiny, and perfectly white vessel with blue ornamentation.

The development of blue-and-white porcelain would have been impossible without the Mongol conquest of nearly all of Asia, which by 1294 had created the largest land empire in human history. This empire connected the most influential cultures of Eurasia, including the Islamic world and East Asia. Cobalt blue pigment, which was the essential colorant in blue-and-white porcelain, had been mined and used by Islamic architects in the decoration of their buildings for centuries. The Shah Mosque in Isfahan, Iran, is one example of an Islamic structure covered in blue ceramic tiles colored with cobalt. Once the blue-and-white porcelain industry was established in China using cobalt imported from Iran and the surrounding region, the Middle East was the first foreign market to embrace these wares.

After it was introduced through trade with the Middle East, cobalt revolutionized the decoration of ceramics in China. This is because cobalt is the only pigment that can maintain its color under the extremely high temperatures required to fire porcelain that is truly



The Shah Mosque in Isfahan, Iran, is one example of an Islamic structure covered in blue ceramic tiles colored with cobalt.

white in color. All other pigments used to color porcelain discolor or melt under such high temperatures.

Blue-and-white porcelains dominated the Asian ceramic trade as early as the fourteenth century. It was during that time that the site of Jingdezhen in Jiangxi province began to produce official underglaze blue porcelains for the court. Jingdezhen is known for its **kaolin clay**, which was used to make porcelain that was extremely pure white, translucent, and strong.

Jingdezhen dominated porcelain production for hundreds of years because of this unique variety of clay. As a result, the town had a massive workforce—tens of thousands of highly skilled potters, artisans, painters, and other professionals in porcelain production who were hardworking and poorly paid. Moreover, the Chinese process of making a blue-and-white vessel had been divided into disparate steps: from dividing the clay, to shaping the vessels, to painting the patterns, with each step finished by a specialist. Such a division of labor made the production process highly efficient, allowing fabrication to reach an industrial scale even before modern industry developed in China.

Finally, the success of blue-and-white porcelain in the global market would have been impossible without the support and investment of Chinese emperors. Chinese imperial workshops established in Jingdezhen were tasked with producing the highest quality and most fanciful designs for the imperial court. As such, these workshops functioned like the national labs of porcelain production, with the most inventive artists and best potters developing new techniques and designs that could be quickly applied to export products, thus ensuring the dominance of Chinese blue-and-white porcelain in the global market.

SELECTED WORK: Jar with Dragon, China, Early Fifteenth Century

The early Ming dynasty was a period of cultural restoration. Ultimately, this ruling house imposed court-dictated styles in the arts. Painters and craftspeople were recruited by the Ming court under strict instruction to return to didactic and realistic modes of representation, and away from more abstract decorative modes. Their goal was to heroize and propagate a taste for the earlier Southern Song (1127–1279) style. Large-scale landscapes, flower-and-bird compositions, and figural narratives were especially favored. These images were viewed as a clear way to glorify the new dynasty by conveying its benevolence, virtue, and majesty.

Produced for the court, the spectacular *Jar with Dragon* storage jar is a good example of porcelain from Jingdezhen. It is dated to the rule of the Xuande emperor by an inscription on its shoulder. The design was painted on an unfired clay body with cobalt oxide before the piece was glazed and fired.¹²

The painting depicts a powerful dragon undulating through a sky that includes a few scattered clouds. The dragon's form seems almost to pulsate as it moves across the soft and fluid contours of the jar, lending the impression of great power with fluidity of movement—qualities prioritized by the artisan who would have painted the decoration on this jar. The unusual monstrous faces on the neck of the jar may derive from the **kirtimukha** (face of glory) that is often found in Indo-Himalayan imagery and was popular in China in the early fifteenth century.

The symbolism of the dragon here could represent the ascendency of the Ming rulers, who adopted the mythical creature soon after taking the throne. At the same time, the overall patterns and decoration reflect

the influence of **Daoism**, a philosophy traditionally credited to the elusive Chinese sage, Laozi. Daoism envisions a dynamic, life-sustaining energy flowing through the universe, a vitality that can fill artists if they are open, flexible, and yielding. In the Daoist worldview, the vital force moves through a great void, apparent in art in the meaningful negative spaces that structure a work and provide its center of interest. Though nearly all Chinese art of this period swirls with abstract lines animated by the energy of the Dao, artists also discovered the power of empty areas. They understood that a visual silence can be more arresting than a commotion of shapes. Blue-and-white porcelain is based on these principles.

A Global Trade

Blue-and-white porcelain is celebrated today as one of the first truly global consumer products in world history. Chinese ceramics were first exported in large quantities during the Song dynasty (960–1279). With government support, seaports were established in Guangzhou (Canton), Quanzhou, Hangzhou, and Ningbo to facilitate this beneficial commercial activity. The global trade in ceramics was sustained throughout the succeeding Yuan dynasty (1279–1368) and continued in the Ming (1368–1644) and Qing (1644–1911) dynasties.

By the fifteenth and sixteenth centuries, objects from Ming China were among the most sought-after export items in Europe, and large quantities of blue-and-white porcelain were exported to Europe, first through Portuguese merchants—who made vast fortunes through their trade between East and West—and then by the Dutch East India Company and many others. As the trade expanded, Chinese craftspeople began to imitate European shapes and patterns to make their wares more attractive to European consumers. One such example is an odd-looking double-necked **bottle** that emulates glass condiment bottles designed to separate oil and vinegar.

By the seventeenth century, more and more Chinese and Japanese ceramics were being made explicitly for export and traded in large quantities. Finally, in the eighteenth century, “china,” as Westerners called fine porcelains, was a major Chinese export easily found on every continent, and a status symbol in both Europe and the American colonies. A custom set of blue-and-white porcelain was even commissioned by George Washington for his private use.

Chinese products were prized for their incomparable quality. Artisans and potters across Europe and the Middle East tried and failed to produce ceramics matching the high quality of Chinese porcelain. As a result, blue-and-white porcelain was revered and even mythicized in the minds of consumers, and the fashion for Chinese porcelain thrived.

China’s glorious period of global dominance in the china trade did not come to an end until the nineteenth century, due to changes brought on by the Industrial Revolution. During that time, British potters found a way to produce porcelain without kaolin clay; they used ashes from animal bones instead. The resulting product was called **bone china**. Bone china could be mass-produced by machines and at a quality matching that of Chinese porcelains, allowing it to quickly outpace Chinese export porcelain in the global marketplace.

SECTION II SUMMARY

Concrete in Ancient Rome

- A hugely significant contribution to the future of architecture and infrastructure across the globe, Roman concrete, or *opus caementicium*, was made from the same basic elements it is still made from today: broken stone, sand, lime mortar, and water.
- Concrete was a key reason for the growth and dominance of the Roman Empire, which ruled nearly all of Europe, North Africa, and West Asia by 117 CE. Roads, bridges, and aqueducts made with concrete facilitated travel, trade, and communication between the far-flung regions of the Roman Empire and enabled its political control.

The Concrete Revolution

- Once Roman architects discovered that adding *pozzolana* sand to mortar produced concrete that was so remarkably durable it could cure under water, the material began to revolutionize building projects across the empire.
- Concrete offered many advantages: it was strong, durable, inexpensive, convenient, adaptable to atypical shapes, and easily worked by unskilled laborers.
- The new medium of concrete allowed Roman builders to develop architectural forms like the arch, vault, and dome. These forms would become the basic units from which most buildings were created. The use of concrete gave vaulted buildings more stability and sunlight and allowed them to be relatively fireproof.

Selected Work: The Pantheon, Rome, 126–128 CE

- Of all the concrete structures built by Roman architects, the Pantheon is one of the most technically advanced. The circular building was constructed for religious worship and was intended to function as a temple to all the gods. (Its name is derived from the Greek words *pan*, meaning “all,” and *theos*, meaning “gods.”)
- In its day, the Pantheon’s dome was an engineering marvel, and it is still today the world’s largest unreinforced concrete dome. The experimental architectural form was the extraordinary result of an increased confidence in the strength and pliability of concrete and the manipulation of concrete’s material permutations.
- For the ancient Romans, the dome and oculus, with their perfect spherical shapes, symbolized eternity and perfection, a reflection of the heavens the space was made to honor. The notable absence of vertical sight lines connecting the Pantheon’s floor to the upper recesses of its dome creates a visual and physical experience of hovering and perpetual motion. Since the building and its larger complex perform such feats of physical and visual manipulation, it comes as no surprise that, upon its completion, the Pantheon became Emperor Hadrian’s favorite place to hold court.

The Art of Memorialization in Ancient Egypt

- Much of the art and architecture that survives from ancient Egypt is funerary in nature, mummification being one key example. This technological process highlights the Egyptian preoccupation with continued material existence in the afterlife.
- The seventy-two-day process of embalming corpses began with the removal of internal organs that might rapidly decay, except for the heart, which was believed to be the seat of understanding and was therefore left intact. The body was then dehydrated, washed, and wrapped in linen.
- The Egyptians’ advanced technological processes of embalming were so successful that we can view the mummified body of an Egyptian today and have a good idea of what they looked like in life some three thousand years ago.

Selected Work: Mummy with an Inserted Panel Portrait of a Youth, Egypt, Roman Period, 80–100 CE

- Following the Roman conquest and colonization of Egypt, Egyptians continued to bury their dead in decorated sarcophagi. But with the influence of Roman artistic styles, the traditional gilded and colorful portraits began to be replaced with painted portraits in a more naturalistic style. Painted in encaustic and originating in the Fayum region, these “Fayum portraits” represent a sea change in the art production of ancient Egypt. They represent a hybrid art form, blending Roman naturalism with Egyptian funerary tradition for a culture that was multicultural and multiethnic.
- Usually painted directly from life, the encaustic panels are incredibly immediate and eerily real portraits of a professional urban middle class.
- Mummy with an Inserted Panel Portrait of a Youth is a rare example of a Fayum portrait that remained intact on the mummy case it was made to adorn, a portrait of the living human whose remains are housed within. Fayum panel portraits like this one can be understood as serving a double pictorial function: they were identifying pictures for the dead in the afterlife

and mementoes for the grieving family, who would have the portrait on display during the seventy-two-day embalming process.

Stained Glass in Gothic Architecture

- Gothic architecture is one of the towering achievements in the history of world architecture. It was the unique product of an era of peace and widespread economic prosperity, deep spirituality, and extraordinary technological innovation.
- Emerging from the standards of Romanesque art, the Gothic style diverges from Romanesque works in the shape of its arches (pointed as opposed to curved). The pointed arch offered more flexibility, required less buttressing, and allowed for thinner walls with larger windows. The advent of the flying buttress at the Cathedral of Notre-Dame in Paris was a big step forward, enabling builders to open the walls to enormous windows of stained glass.
- Though not a Gothic invention, stained glass windows were such an integral part of Gothic architecture that they are essentially synonymous with it. Period texts inform us of the demands of making this material: it required a molten mixture of silica (basically sand), potash (to lower the temperature at which silica melts), and lime (a stabilizer), plus the addition of metal oxides to color or “stain” the glass. This process was costly and labor-intensive, requiring the involvement of many trained artisans.

Lux Nova

- By the twelfth century in Europe, stained glass was both a refined art form and a religious phenomenon. Not only decorative, the colored light produced by stained glass was meant to convey and heighten a sense of the divine pouring in from above, and it also provided a platform for Christian imagery.
- Abbot Suger—the influential church official, statesman, and historian—called this colored light *lux nova*, Latin for “new light.” Suger used the phrase to describe the heavenly aura of celestial radiance born from the colored light that literally and metaphorically lit up the church along with the hearts of the faithful.

Selected Work: South Rose Window of Chartres Cathedral, France, 1221–30

- Chartres Cathedral in France offers a unique example of High Gothic architecture that was completed in a relatively short time and is thus relatively uniform in style. The cathedral contains the world’s largest surviving collection of medieval stained glass.
- While churchgoers were mostly illiterate, they were fluent in understanding the rich symbolism depicted in the windows. At Chartres, glaziers carefully planned entire iconographic programs for stained glass cycles relating stories from the Old and New Testaments of the Bible.
- The rose windows, which symbolically represented the coming together of many parts to make a balanced whole, were the centerpiece of this iconographic program. Their circular shape evoked perfection and eternity in a visually pleasing design.
- The theme of the south rose window at Chartres is the Glorification of Christ, who is represented at the center of the window surrounded by angels and the Elders of the Apocalypse. With its spherical design evoking the spinning wheel, the window reads like a dream vision of the future end of the world where Christ reigns supreme at the heart of heaven. In the lancet windows below are portraits of the window’s donors.
- In the Gothic period, the mystical jewel-toned light pouring through these windows would have encouraged meditation and prayer. Reflection on the stories of Christianity could offer viewers hope and purpose beyond the struggles of their daily lives.

Chinese Ceramics and the Kiln

- In the premodern period, ceramics represented cutting-edge material science, and Asian cultures were the global leaders in this advantageous, practical, and beautiful technology.
- By 200 CE, Chinese artisans had developed massive dragon kilns, which produced the world’s first porcelain objects. Porcelain differs from stoneware in its beauty, delicacy, and elegance.

Blue-and-White Porcelain

- Production of blue-and-white porcelain began after the Mongol conquest of the Eurasian continent, which resulted in the largest land empire in human history. Once the blue-and-white porcelain industry was established in China, using cobalt imported from Iran and the surrounding region, the Middle East was the first foreign market to embrace these wares.
- Cobalt pigment revolutionized the decoration of ceramics in China because it is the only pigment that can maintain its color under the extremely high temperatures required to fire white porcelain. The discovery of kaolin clay in Jingdezhen also drove the industry forward, as this particular clay produced porcelain that was the purest white, translucent, and strong.
- As a result, Jingdezhen dominated porcelain production for hundreds of years, developing a massive workforce divided in a highly specialized manner to increase production. The financial support of the Chinese imperial court also spurred innovation in Jingdezhen, thus ensuring the dominance of Chinese blue-and-white porcelain in the global market.

Selected Work: *Jar with Dragon, China, Early Fifteenth Century*

- Produced for the Ming court, this jar is an example of porcelain from Jingdezhen. The design was painted on an unfired clay body with cobalt oxide.
- The painting depicts a powerful dragon

undulating through a sky defined by a few sparse clouds. The symbolism of the dragon here could represent the ascendency of the Ming rulers, who adopted the mythical creature soon after taking the throne. At the same time, the overall patterns and decoration reflects the influence of Daoism, a philosophy that envisions a dynamic, life-sustaining energy flowing through the universe.

A Global Trade

- Blue-and-white porcelain is celebrated today as one of the first truly global consumer products in world history. With government support, seaports were established to facilitate this beneficial commercial activity as early as the tenth century CE.
- By the fifteenth and sixteenth centuries, objects from Ming China were among the most sought-after export items in Europe, and large quantities of blue-and-white porcelain were exported to Europe. By the eighteenth century, “china,” as Westerners called fine porcelains, was a major Chinese export easily found on every continent and a status symbol in both Europe and the American colonies.
- Artisans and potters across Europe and the Middle East tried and failed to produce ceramics matching the high quality of Chinese porcelain. Not until the nineteenth century, due to changes brought on by the Industrial Revolution, would China’s glorious period of global dominance in the china trade end and be replaced by British-made bone china.

SECTION III

Art, Technology, and the Advent of Global Trade

THE COMPASS AND THE FULL-RIGGED SHIP FORGE A NEW WORLD

By the end of the fifteenth century, ancient practices of sea navigation rapidly advanced in response to the needs of oceanic explorers. In order to find their way to foreign lands and back home again, these men needed to be able to accurately calculate their geographic positions on the open ocean. The wide use and manufacture of magnetic compasses had an inestimable impact on early navigation and exploration. Invented in China, by the late Middle Ages compasses had become the principal instrument for mariners navigating the open oceans, replacing astronomical methods.

The compass, unlike the stars, was incredibly reliable: it could be used effectively day or night and was never negated by cloudy skies. This small tool forged a massive breakthrough, igniting the so-called “Age of Discovery,” when nearly every major European power sent explorers to gather knowledge about marketable goods in new lands and to claim them for their own. This period began in the fifteenth century and lasted until the seventeenth, but its height spanned the decades between 1492 and 1565.¹³

In combination with the compass, the early fifteenth century saw the rise of the full-rigged ship. With three masts and five or six square sails, these ships were much larger, heavier, faster, more maneuverable, and newly reliable in the brutal conditions of the open ocean. Before, Europe and Asia had exchanged trade goods via caravan routes over land, such as the Silk Road. But these journeys required enormous amounts of time, labor, and money. With the introduction of the full-rigged ship, faster and cheaper trade routes were established, connecting the globe as never before. By the end of the fifteenth century, Vasco Da Gama,

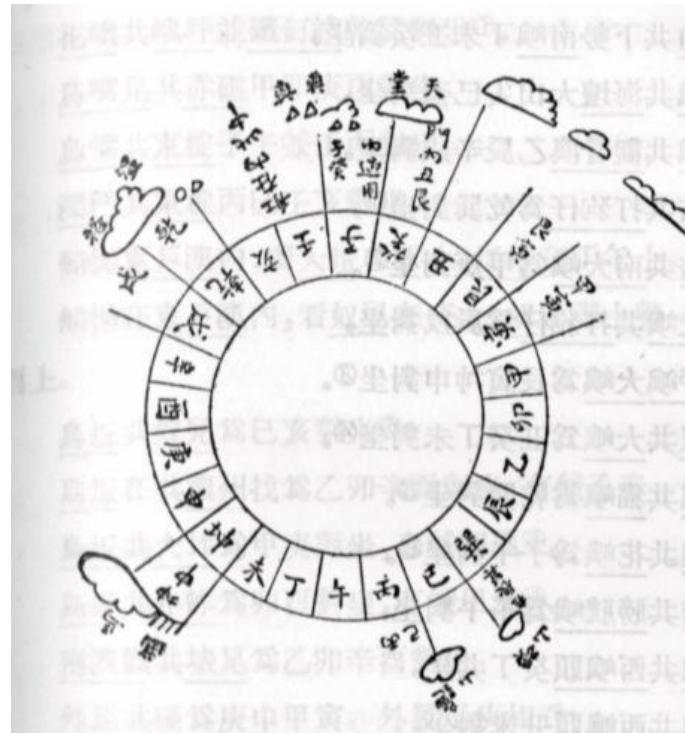


Diagram of a Ming dynasty mariner's compass.

Christopher Columbus, and John Cabot had made revolutionary journeys to quite literally redraw the world map.

These technological advances defined an age transformed by human exploration and discovery, marking the beginning of our own period of global exchange. As European powers raced to excavate wealth from the New World—at times forcibly—they opened up new avenues for the exchange of raw materials, finished trade goods, and new knowledge. From Venetian glass, which required imported ingredients from Egypt and Syria, to the sale of a deep blue stone from Afghanistan called lapis lazuli that was included in some of Europe’s most prestigious Renaissance paintings, the advent of global trade transformed the history of art.

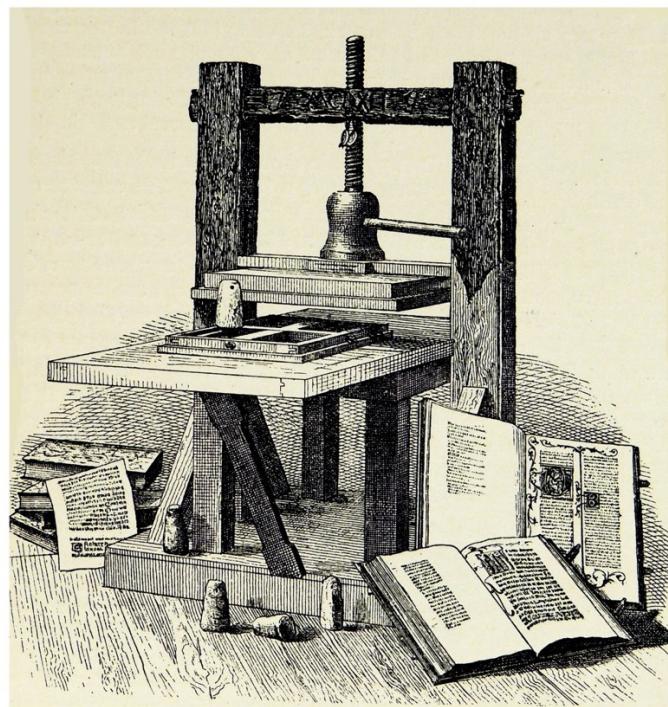
GUTENBERG'S PRINTING PRESS

The compass and full-rigged ship were not the only major technological innovations to effectively connect the world through the global trade of goods and ideas. Prior to the rise of the Internet, no technology has done more for the spread and democratization of knowledge than the printing press. While tradition has credited Johannes Gutenberg with inventing moveable type in Mainz, Germany, around 1440, the roots of printing lie in the ancient Near East some five thousand years ago. The Sumerians were the earliest “printers,” producing relief impressions on clay that were made from stone seals carved with both images and inscriptions.

From Mesopotamia the use of seals spread to India and eventually China, where craftspeople applied ink to carved seals and pressed them onto wood or silk. In the second century CE, the Chinese invented paper, which provided a lightweight and light-colored vehicle for dark ink. By the ninth century, Chinese printmakers had established regular book- and print-making trades using wooden blocks carved in relief. And by the eleventh century, they had developed moveable type—a printing technology employing endlessly arrangeable, reusable, individually carved letters. But this wooden typography was not very durable as the soft material wore out quickly, and the porous wood absorbed a great deal of ink. Because of these failings, moveable type was largely abandoned.

Abandoned, that is, until 1297, when it was reintroduced by Wang Chen and his publication on agriculture and farming called *Nung Shu*. Chen improved moveable wooden text by developing a process to make the blocks more durable. He also facilitated the process of ordering and arranging the moveable type for typesetters (workers who prepared the blocks by arranging them in flat trays). Chen's advances made *Nung Shu* the world's first mass-produced book. It is possible that this or other early examples of Chinese books made with moveable type may have reached the medieval West, likely through Islamic intermediaries.

In Germany around 1440, Gutenberg's printing press adapted moveable type and preexisting presses to develop a mechanical press that could apply pressure to the inked surface of the letter type and a print medium such as paper or cloth. Gutenberg's press employed a screw-type wine press to push down evenly on the inked metal type. In this way, his machine was the key



Johannes Gutenberg's first printing press.

to unlocking moveable type technology by allowing for the rapid production of multiple printed pages from lead alloy type pieces. By 1500, more than a thousand Gutenberg presses were operating in Europe, and by 1600 they had created more than two hundred million new books. This technology spread quickly across Europe, giving rise to a new industry: bookmaking.

With the newfound ability to inexpensively mass-produce books, ancient knowledge as well as revolutionary new ideas were newly available to literate Europeans, whose numbers doubled every century. The rise in literacy was to have a profound impact on Western civilization. While the Italian Renaissance began roughly a century before Gutenberg's technology revolutionized the distribution of printed knowledge, the newly efficient printing press accelerated the revival of ancient educational texts by figures like Plato and Aristotle. Texts on artists, artmaking, and artistic principles also played a key role in advancing the Renaissance in art across major European cities.

PRINTMAKING

In the arts, printmaking was already well established by the time Gutenberg's development of moveable type printing took off. The technique was developed in order to make multiple copies of the same image from a carved slab of wood or metal called a matrix.

The matrix is rolled with ink and transferred to paper through the force of a press. As you can see in Albrecht Dürer's carved woodblock for *Samson Rending the Lion* and the resulting print, the raised portions of the block hold the ink, which is then transferred to the paper during printing.

From the start, words were linked with images in the books made on Gutenberg presses. But as literacy rose and increased wealth created new markets for illustrated books, artists met the challenge of incorporating printed images into pages with letterpress text. By 1500, printing technology allowed illustrations by several methods to be printed alongside text.

In a woodcut (also called a woodblock print), a design is carved directly into a wooden block with chisels, gouges, or knives. Woodblock prints are the oldest form of printmaking, dating to before 220 CE in China. An early example from the age of Gutenberg's printing press is the 1423 print Buxheim St. Christopher. Named for the south German town from whence it came, this hand-colored woodcut combines image and text with simple, heavy lines that define the forms of the saint, Christ, and their surrounding landscape. Thinner lines in parallel rows—called hatching—denote shadows or textures of objects. Look, for example, at the inner contours of the cliff face, where rows of vertical lines indicate depth and recession into space. As print techniques developed, hatching would become much more advanced, promoting the illusion of space and dimensionality in a two-dimensional image.

The technique of engraving—embellishing metal surfaces with incised pictures—had developed in classical antiquity and continued during the Middle Ages. Goldsmiths and especially designers of armor were experts in incising designs on metal surfaces, skills that allowed them to engrave a plate that could serve as the matrix for a print on paper. In engraving technology, lines are cut into a metal plate of copper, aluminum, or zinc with a burin (a steel shaft with a diamond-shaped tip). These incised lines then hold the ink, which is transferred to the page during printing. More durable than wood, metal plates allow for more impressions to be made before they begin to deteriorate. The process of engraving also allows for more diversity and fluidity in line-making and more subtle use of tone and shading, meaning engravings



Buxheim St. Christopher, 1423. Hand-colored woodcut,
John Rylands.

University Library, Library of Manchester

have the capacity to be more complex in design.

Lighter, smaller, and more transportable than large-scale artworks, prints played an incredibly important role in the transference of ideas and the spread of artistic knowledge and iconography, especially during the Age of Discovery. Prints allowed architectural designs for Baroque churches, for instance, to be sent from European centers to South America, where buildings were constructed from these plans. So too were prints used to convey factual visual knowledge about the world—in maps, images of flora and fauna, anatomical and surgical treatises, and cosmographical charts, as well as tracts on arms, armaments, and engineering. Prints could also reproduce artworks only accessible in-situ, such as Michelangelo's Sistine Chapel ceiling, allowing artists to study these masterworks in their studios, from London to Rio de Janeiro and everywhere in between.

SELECTED WORK: *Melencolia I*, Albrecht Dürer, 1514

In the hands of Albrecht Dürer, both woodcuts and engravings reached a pinnacle of sophistication. A supremely gifted and versatile German artist of the Renaissance period, Dürer was born in the Franconian city of Nuremberg. His richly luminous and textured prints have inspired artists for generations—even Raphael is said to have hung Dürer’s prints in his studio—because of his advances in the technical and conceptual range of the print medium.

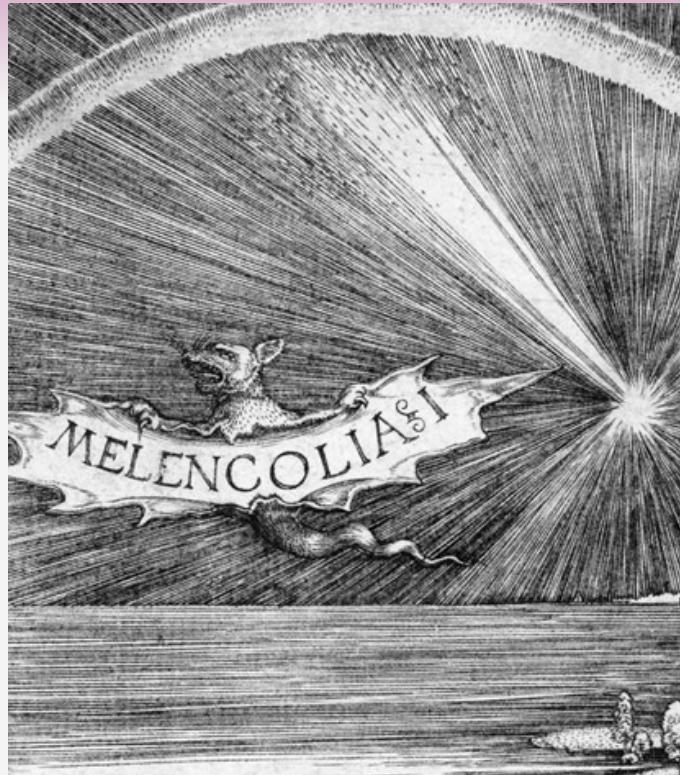
Dürer promoted his graphic art with the astute skills of a preeminent businessman. With the help of his wife, his mother, and an agent, the artist aggressively marketed his engravings and woodcuts, achieving fame and financial success. In 1506, in an unprecedented effort to protect his own financial interests, Dürer filed the first lawsuit over artistic copyright, accusing another artist of copying his work without permission.

One of the artist’s best known and most enigmatic images, *Melencolia I*, is a depiction of the intellectual situation of the artist and is thus, by extension, a spiritual self-portrait of Dürer himself. The engraving is dated to 1514 and represents a winged female figure holding a compass. However, as opposed to a magnetic compass used in navigation, this instrument with two long thin parts joined together at the top is used for drawing circles and measuring distances on a map. Though the winged figure is surrounded by the tools of the mathematician and the artist, she does not actively use the disorganized tools that lie about.

Her face is shadowed as she sits in a pose long associated with melancholy, which contemporaries connected to intellectual activity and creative genius. In fact, Renaissance-era medicine held that those with too much black bile were melancholic and therefore more likely to succumb to insanity. But melancholy was also linked to creative genius. Hence the self-conscious artist was aware that his gift came with terrible risks. In Dürer’s image, the winged personification of Melancholy, seated dejectedly with her head resting on her hand, is surrounded by other tools associated with geometry, one of the seven liberal arts that underlies artistic creation.

Dürer’s figure thinks but does not act, while behind her, a winged infant scrawling on a slate—symbolizing practical knowledge—acts but does not think. In this conception of artistic creation, melancholy brings on bouts of unproductive introspection. All is not darkness and angst, however. Dürer also included a burst of light on the far horizon—an optimistic note suggesting, perhaps, that artists can overcome depressive melancholy to produce works of great genius. Dürer thus appears to be making a statement about the artistic spirit and its relationship to the melancholic humor.

The physical volume of the figures and objects in the scene reflects the influence of Italian art, which prized



Detail of Dürer’s Melencolia I. The Roman numeral I on the bat’s banner indicates the first level of melancholy—specifically, artistic melancholy. The shining ray of light (indicated by the raised metal plate and lack of ink) offers some relief to the dreary image, suggesting a more hopeful message: that the artist might overcome melancholy to achieve works of great genius.

the illusion of volume and dimensionality—as we will explore further with Fra Filippo Lippi and the invention of linear perspective. The visual dynamism of Dürer's print results from the artist's deployment of a wide range of hatch marks, lines of varied widths, strong contrasts between darks and lights, and interspersed use of **stipple engraving** (designs made by a series of small dots engraved on the metal surface of the matrix).

When compared to the woodblock print [Buxheim St. Christopher](#) from nearly a century before, we can see just how far Dürer advanced the print medium.

While we may never know the engraving's full meaning, we can be certain that it touches upon many of Dürer's central interests: the role of the artist as creator; the relationships among the physical, intellectual, and spiritual realms; the study of the natural world and mathematics; and self-awareness.



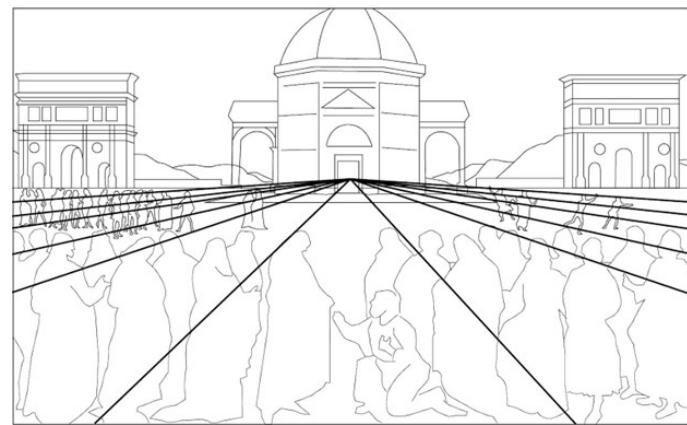
Detail of Dürer's Melencolia I. Scattered around Dürer's seated personification of Melancholy are the tools of the artist and builder—compass, hammer, saw, nails. But they lie scattered on the floor, unused by the depressive artist.

THE INVENTION OF LINEAR PERSPECTIVE

One of the genuinely transformative inventions of the Renaissance period was linear perspective—also called scientific perspective or one-point perspective. The term refers to a systematized, geometrically based procedure for projecting the illusion of space onto a two-dimensional surface, allowing the flat picture plane to become a window into another world. Images organized by the system of linear perspective are convincingly realistic, illusionistic, and transportive.

In the ancient world, only Greek and Roman artists mastered the rendering of spatial depth in images. However, this knowledge was lost during the medieval period. By the fourteenth century, Italian artists such as Giotto, Duccio, and the Lorenzetti brothers had used several optical devices to suggest distance within the picture plane. But it was not until the Italian architect, designer, and sculptor Filippo Brunelleschi invented linear perspective that Renaissance-era artists developed a method for creating the illusion of spatial distance within a picture via a process that was certain and consistent.

Linear perspective enables artists to mathematically determine the relative size of rendered objects to correlate them with visual recession into space. To do this successfully, an artist must first identify within the image a horizontal line that marks the horizon in the distance (hence the term “**horizon line**”). The artist then selects a **vanishing point** on that horizon



Perspective image with Pietro Perugino's Delivery of the Keys, 1482, showing the central vanishing point, horizon line, and orthogonals.

line (often located at the exact center of the line). By drawing **orthogonals** (diagonal lines) from the edges of the picture to the vanishing point, the artist creates a structural grid that organizes the image and determines the size of objects within the image's illusionistic space. This method for creating a realistic illusion of space remains a standard element of drawing instruction to this day.

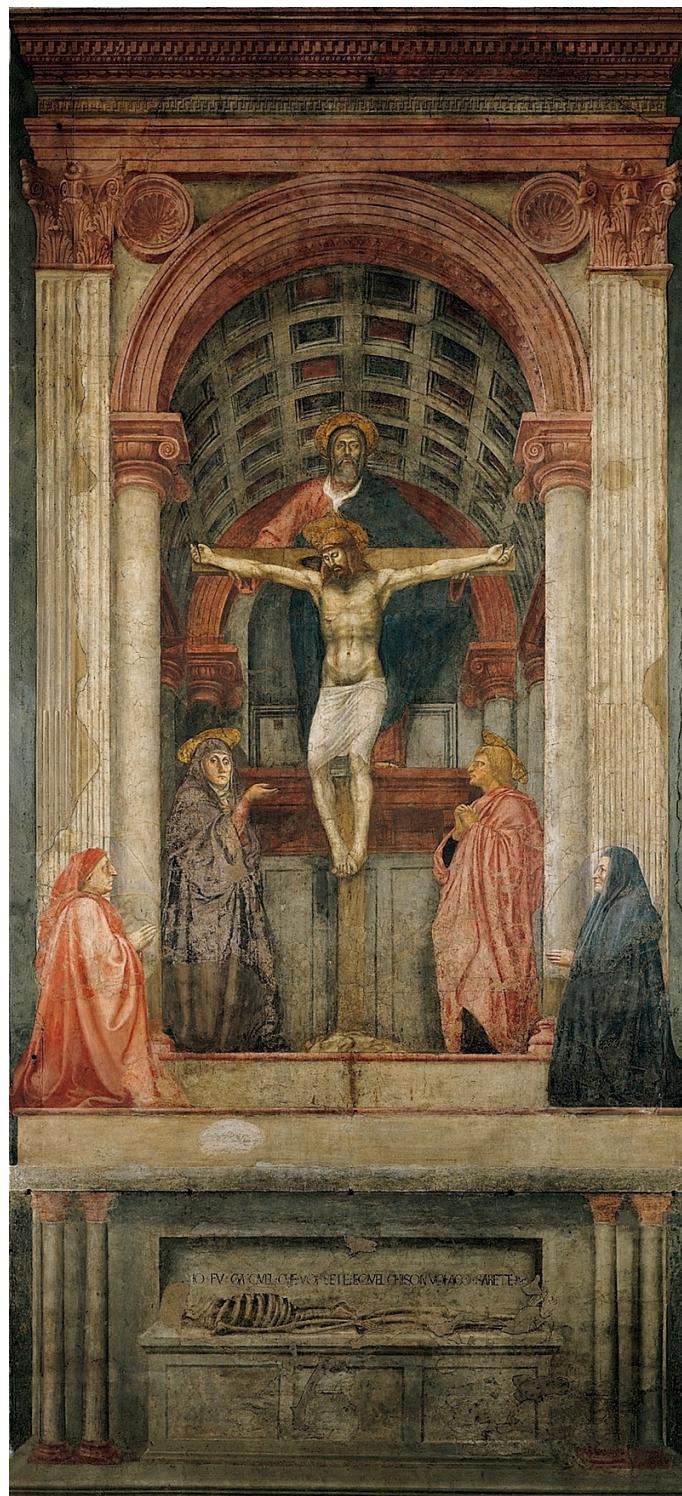
One of the earliest examples of the application of mathematics to the depiction of space according to Filippo Brunelleschi's system of perspective is Masaccio's [Holy Trinity](#). All orthogonals meet at a single vanishing point, which appears at the center of the composition for a viewer standing before the fresco. This effectively completes the illusion of continuity between the real space of the spectator and

the fictive space of the painting.

The Renaissance-era rediscovery of perspective represents a sharp transition from the portrayal of space during the Middle Ages, when religious needs overcame the desire to depict objects illusionistically. Look again, for example, at the [Buxheim St. Christopher](#) print, and you will see how the saint and Christ are rendered larger than the figures in the surrounding landscape. This unrealistic rendering of the figures emphasizes Christ's prominence within the image's narrative. (This convention of sizing human figures based on status is known as **hierarchical scale**.) Ultimately, the adoption of linear perspective was an early symptom of the secularization of culture—scientific thinking was beginning to overtake spiritual belief systems.

The impact of this technology on the history of art cannot be overstated. Combining mathematics, science, and vision, linear perspective effectively established a new way of seeing and conceptualizing the world. By organizing all visual phenomena under the single ruling principle of perspective, expressed mathematically, linear perspective made possible the rationalization of sight. As such, the emergence of linear perspective at this moment reflects the emergence of modern science and its adoption at every level of society and culture.

The illusion of three dimensions within a two-dimensional image not only impacted the art of the time, but also made possible scale drawings, maps, charts, graphs, and diagrams—exact methods of representation that could transfer knowledge with precision across and between distant lands. During an age of global trade, this techno-mechanical system was invaluable, laying the foundation for modern technology and science.



Masaccio, *Holy Trinity*, Santa Maria Novella, Florence, Italy, c. 1424–27. Masaccio's pioneering Holy Trinity is the premier early fifteenth-century example of the application of mathematics to the depiction of space according to Filippo Brunelleschi's system of perspective.

SELECTED WORK: *The Annunciation*, Fra Filippo Lippi, c. 1450–53

As fortunes in Renaissance Florence rose—primarily through the manufacture and trade of woolen cloth—wealthy patrons like Cosimo de' Medici built great palaces requiring extensive decoration. Furnishings and décor were made by local artists to express the social standing, wealth, and religious devotion of these powerful families. One example of this type of domestic decoration is Fra Filippo Lippi's *The Annunciation*. Commissioned to decorate the Palazzo Medici in Florence, the egg tempera painting on a semi-circular wood panel (this shape is called a lunette) was likely made to hang over a door or bed.

The painting depicts the Annunciation of the Virgin Mary—the announcement of the immaculate conception of Christ—with the archangel Gabriel at left. At the top of Lippi's composition, the hand of God is visible. Reaching down from heaven, it gestures to Mary in a sign of divine blessing. The affirmation is further symbolized by the white dove hovering over her lap. Around the middle of the fifteenth century, the subject of the Annunciation had become exceedingly popular in the art of Florence.

Fra Filippo Lippi, a key painter of the Italian Quattrocento, often depicted the subject. In his circa 1450–53 rendering, which is one of our selected works, a perspectival scheme defines the space. He accomplishes the illusion of recession into space with the incorporation of architectural elements like the geometrically patterned floor tiles (at right) and receding balustrades with garden foliage (at left). These clear geometries, naturalized as part of the scene's setting, make the orthogonal lines of Lippi's linear perspective visible. For contemporary viewers, this made the deception of recession into space more convincing. It was a relatively common practice in Renaissance-era composition design.

With its simplicity and spatial sophistication, Lippi's *Annunciation* demonstrates the influence of earlier masters of perspective like Masaccio, especially in the focus on linear perspective to organize a scene. Lippi was in fact exposed to Masaccio's works as a teen when he, as an orphan, lived in a monastery adjacent to the church of Santa Maria del Carmine where he likely witnessed Masaccio's decoration of the Brancacci Chapel.

While this work offers a good example of the effective deployment of linear perspective, its imagery maintains older traditions of unrealistic Christian symbolism. The hand of God, for example, along with the dove and golden haloes behind the figures' heads are all visualizations of invisible phenomena. As such, we can understand Lippi's *Annunciation* as a rationalization and realization of a holy narrative, a bringing-into-being of divine presences.

FILIPPO BRUNELLESCHI'S DOME AND RENAISSANCE ARCHITECTURE

The basic geometry of linear perspective was first codified in printed form in architect and writer Leon Battista Alberti's *De Pictura*. Printed in 1435, this treatise was developed after Alberti's return to Florence after years of exile. Alberti commented that while he had formerly “believed...that Nature...had grown old and weary, and was no longer producing intellects,” the achievements of Florentine artists rapidly convinced him otherwise. Above all, it was Filippo Brunelleschi's great dome of the Florentine



Brunelleschi's dome at the Duomo in Florence.



Workshop of Robert Campin, Annunciation Triptych (Merode Altarpiece), c. 1427–32.

The Metropolitan Museum of Art, The Cloisters Collection.

cathedral, a feat “probably equally unknown and unimaginable among the ancients,” that demonstrated for Alberti that “rebirth” was truly underway.¹⁴

Soaring hundreds of feet above street level, the dome of the Florentine Duomo reigns over Florence. Through his deep study of Gothic, Roman, Byzantine, and perhaps Persian buildings, it is likely that the architect discovered linear perspective as a way to accurately record the appearance of these buildings. But the actual building of the dome was a great departure from these precedents. It was a feat of engineering and style and would come to represent the inventiveness, piety, ambition, and skill of the Florentine Renaissance.

Until Brunelleschi’s involvement, the cathedral in Florence had remained unfinished for many years because architects had not been able to construct the enormous vault required to span the open space. Brunelleschi’s winning proposal to complete the long-unfinished dome consisted of a double-shelled design that has since been imitated by many later architects. During Brunelleschi’s time, this method was more common in Islamic than Italian architecture, particularly in Persia. Thus, Brunelleschi’s design indicates the exchange of ideas between the regions during this era of increasing global trade.

The two interlocking shells of Brunelleschi’s dome are supported by a series of ribs, eight of which are visible on the exterior of the dome. The dome’s vertical ribs are supported by horizontal ones. The dual shells effectively lighten their mass since their walls could be thinner relative to their size. This system may well have been inspired by the coffered dome of the Pantheon in nearby Rome, discussed in the previous section. But in the Duomo, the marked use of ribs and the pointed profile of the arches reflect the influence of Gothic architecture. Brunelleschi’s use of brickwork instead of concrete marks an advance in that building material by using a herringbone pattern to lessen the weight as the layers rise. This method also helps the brickwork to resist cracks caused by settling. Taken as a whole, Brunelleschi’s architectural scheme for the dome of the Duomo reflects a bold, analytical plan that advanced modes of design based in antiquity and the Middle Ages.

THE ADVENT OF OIL PAINT AND CANVAS

Just as the invention of linear perspective allowed for the advancement and adoption of realism in the visual arts, the advent of oil paint as a medium solidified and honed this drive toward the illusion of reality.

in painting. The adoption of oil paint by Europeans began with Early Netherlandish painting in Northern Europe. By the zenith of the Renaissance, oil had almost completely overtaken egg tempera paints in the majority of European painting studios.

In the medieval period, the basic medium of panel painting was tempera, in which the finely ground pigments were mixed (or “tempered”) in diluted egg yolk, which served as the binding agent. Tempera produced a thin, tough, quick-drying coat that produced high-key color surfaces. However, in tempera the different tones on the panel could not be blended smoothly, and the progression of values necessary for three-dimensional effects was difficult to achieve. While medieval artists had used oil-based paints for special purposes, such as painting on metal, it was not until painters like Jan van Eyck and Robert Campin began to exploit the medium for panel pictures in Flanders that the medium took off. Instead of mixing finely ground pigments into diluted egg yolk (as in tempera), these and other artists working in oil suspended the pigments in an oil—most commonly linseed oil.

Compare, for example, Fra Filippo Lippi’s [Annunciation](#), which is rendered in egg tempera, to the [Merode Altarpiece](#), a work with the same subject matter albeit in oil on wood panel. As you can see, the advantages of oil for painting images are nearly overwhelming. The medium offered artists previously unmatched degrees of facility to fuse tones and colors, making it unique among fluid painting mediums. At the same time, oil paint permits the layering of opaque pigment layers, allowing artists to achieve crisp lines and intense linearity in forms. Oil paint can also create objects that appear transparent or translucent, allowing painters to render gauzy veils and gossamer laces with acuity. The textural variation offered by such a medium was unsurpassed, causing a real revolution in artists’ materials in the fifteenth and sixteenth centuries.



Detail Annunciation Triptych (Merode Altarpiece).

In addition to oil paint, [canvas](#) proved a huge advance for painters. For much of the Middle Ages and Renaissance, painters worked either directly on walls or on solid wood supports. While durable, wood is heavy and susceptible to warping. Originally introduced in fourteenth-century Italy as a more affordable and portable alternative, canvas is made of a strong, tightly woven fabric that is stretched tightly across a wooden frame and primed with a paint binder called [gesso](#).

In the humid climate of Venice, neither [fresco](#) (a painting done rapidly in watercolor on wet plaster on a wall or ceiling to become physically integrated into the building) nor wood panels could easily survive for long periods. As such it was in swampy Venice that artists first began preferring canvas supports in earnest, especially for large-scale projects. By the middle of the sixteenth century, canvas had spread across Europe as the preferred support for painters, replacing wood panels altogether by about 1600. The smoother surface, durability, portability, and lower price point of canvas have made this material the most popular support for paintings for the past four hundred years.

SELECTED WORK: Judith and Her Maidservant with the Head of Holofernes, Artemisia Gentileschi, c. 1623–25

By 1600, the primary charge of the Renaissance had waned, and the artistic center of Europe had moved south from Florence to Rome. So too had artistic styles changed—with help in part from the sweeping adoption of oil on canvas as the primary medium in painting. Today we call the exuberant, expressive style associated with the seventeenth century the [Baroque](#). The term may derive from the Portuguese word for an irregular

pearl—*barroco*—which connotes something luxurious yet contorted, even grotesque. While at the time the word “Baroque” was invented by critics to disparagingly describe the style’s grandiose, turbulent, and overwhelmingly dramatic style, today we can appreciate the theatricality and power of this aesthetic mode.

Working in Rome at the height of Baroque production, Artemisia Gentileschi is an early example of a woman artist who built a successful career for herself in a society dominated by men. Gentileschi was trained from a young age by her artist father, but her success was hard won. In 1649 she wrote in a letter, “people have cheated me” after she had submitted a drawing to a patron only to have him commission “another painter to do the painting using my work. If I were a man, I can’t imagine it would have turned out this way.”¹⁵

Deploying the strengths of the oil on canvas medium, Gentileschi created strikingly realistic images depicting lush fabrics, flesh, hair, and even blood. Oil paint enabled her to develop a highly naturalistic style, featuring meticulous attention to detail that imparted a sense of drama and realism to emotionally fraught imagery.

Indeed, Gentileschi was famed for painting women of strength, passion, and vulnerability. She did not shy away from violent subjects in her compositions, instead deploying female ferocity as a tool to heroize women protagonists.¹⁶ Judith is one such mythic figure, painted multiple times by Gentileschi. A story from the Bible’s Old Testament tells us how Judith, a Jewish widow, saved the city of Bethulia from the Assyrians by killing their general, Holofernes, who was preparing to lead an attack on the Jews. Dressed in her finest clothes, Judith entered the enemy camp as a spy. After dining with Holofernes in his tent, she waited for him to fall asleep before cutting off his head with his own sword. In doing so, the story says, she saved her people. This theme was popular during the Baroque era, which delighted in erotic and violent scenes.

In this composition, Gentileschi imagines the aftermath of Judith’s violent act. Judith and her maid servant are clearly fearful of discovery in the midst of escape. Judith holds Holofernes’s oversized sword in her right hand, a gesture indicating what has recently taken place, while her left hand reaches out in alarm toward the action that takes place just beyond the frame of the image. At the bottom of the frame, her maid servant shoves Holofernes’ head in a sack. Tension washes the scene with fear—is someone about to walk in to witness the aftermath of this illicit, albeit heroic, act? The golden light illuminating the scene from the left further emphasizes this heightened, climactic moment within the story. This strong use of contrasting light and dark in the painting’s palette is called **tenebrism** and is a hallmark of the Baroque style in painting. In Gentileschi’s *Judith and her Maid servant with the Head of Holofernes*, it makes the scene with its wrought emotions of furtive haste and desperate secrecy still more vivid and intense.

Scholars of Artemisia Gentileschi and her work often make note of the fact that the artist was raped at a young age by her teacher, the artist Agostino Tassi. Following a public trial, the man was sentenced to banishment from Rome. This biographical detail, once known, seeps through our reading of her works to color her seeming ambivalence toward men and her frequent heroization of women. And it offers, perhaps, another dimension to our understanding of the force and clarity of Gentileschi’s masterful naturalism in oil on canvas: through the precision of her realism, she enhanced the fierce bravery of her female protagonists.

THE INVENTION OF CRISTALLO GLASS

After bronze, glass is the oldest of all manmade materials. While clear, tough glass is an inexpensive and common material in our homes today, during the Renaissance glassmaking was a complicated, labor-intensive, and expensive industry. The development of

cristallo glass in Venice thus offered a great advance in glassmaking during the middle of the fifteenth century. The glass was named for the vaunted *rocca di cristallo* (“rock crystal” in Italian), which it resembled in clarity and colorlessness. Cristallo quickly became a luxury tableware in incredibly high demand throughout Europe and the Middle East for decades, with its secrets carefully guarded by Venetian glassblowers.



This unadorned goblet made of cristallo glass evidences the new technology for producing perfectly colorless glassware developed by Venetian artisans around 1450.

At the dawn of the Renaissance, Venice was one of the richest states in Italy and the major commercial and cultural link between Europe and the Byzantine Empire. With a large fleet of ships and geographic connections to the Byzantine Empire and Persia, Venice was in a perfect position to make this luxury glass. Raw materials were imported from other parts of Europe as well as the Middle East to fuel the city's glassmaking industry: from rocks that would be ground down and then melted, to rare colorants and hardwoods that would fuel the furnaces required to produce the glass.

The process for making cristallo was discovered around 1450 by Angelo Barovier, a chemist working on the island of Murano outside Venice. Barovier devised a method, called lixiviation, for purifying the plant-ash flux that resulted in a perfectly clear glass. Before cristallo, glass was not associated with transparency



An enameled cristallo stem glass from around 1500.

in the way it is today, as at that time, glass had thick walls and a yellow or greenish color. Hence the experience of absolute transparency in glassware was viewed as a privilege of those who could afford the precious material. From the incredibly clear cristallo glass, Venetian glassblowers produced thin glasses in simple but elegant shapes, which were shipped and sold throughout Northern and Eastern Europe and the Islamic East.

Many European glassmakers tried to copy the superior colorless glass of Venice, but strict laws regulated the export of raw materials and technical knowledge from that city. Beginning in 1291, legal statutes restricted all glassmaking to the island of Murano. This served to physically isolate the glassmakers and reduce the risk of fire, while also controlling their movements. If any glassmakers were discovered sharing secrets of how to make cristallo, or trying to leave Murano to work

elsewhere, strict punishments were imposed: from fines to imprisonment and even execution.¹⁷

Angelo Barovier's special new technology for producing cristallo required four key ingredients: a former, a flux, a stabilizer, and a decolorizer. The former was silica, a hard, unreactive, colorless compound that occurs as the mineral quartz, a principal constituent of sandstone and other rocks. While glass can be made using beach or river sand, these sources are often accompanied by iron, which turns glass green. By the middle of the fourteenth century, Venetians had found a silica that was reasonably free of iron. They imported these quartz pebbles from the Ticino and Adige Rivers of mainland Italy, pulverized them to a fine sand, and melted them down at high temperature.

The flux was essential for lowering the melting point of the silica, which meant that fires did not have to get as hot to make glass. The flux was acquired in the form of

the special plant ash *allume catina*. As early as 1285, this was imported from Syria and Egypt.

Less clear are the possible sources of the stabilizers Venetians used, which modern chemical analysis reveals to have included such elements as alumina, lime, and magnesia. The last key ingredient in the making of colorless glass was manganese dioxide. The use of this compound as a decolorizer in glassmaking has been known since at least 1290. It was collected in the Piemonte region of Italy and shipped 250 miles west to Venice.

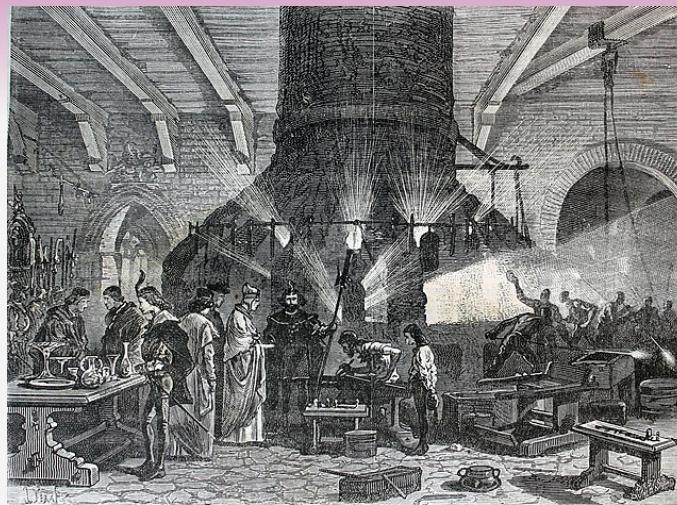
In this way, we can imagine cristallo glass as connecting East and West via trade. Importing pure *allume catina* from Egypt and Syria, as well as other raw materials from across Italy, Venetian glassmakers transformed these ingredients only to ship them back to the regions as a new, finished product.

SELECTED WORK: The Behaim Beaker, probably 1495

Over time, Venetian glass makers developed extensive practices for decorating their glass objects. Extant examples of cristallo show elaborately laden decorations, which encompass everything from Christian religious imagery to secular scenes and heraldry. Venetian artisans decorated the surface of their clear glassware with colored glass canes and fine filigrees, colorful enamels, and gold foils. They also used metal stamps and molds to shape the surface of the glass and etched designs into its surface. In this way, the glass itself became a kind of canvas—a support onto which pictorial designs were applied.

One particularly well-known glass, known today as the *Behaim Beaker*, exemplifies this practice of elaborate decoration. Depicting the Behaim family coat of arms alongside framed tableau images of Saints Catherine and Michael, this cup exemplifies advanced cristallo technologies and evidences the demand for specialized luxury trade goods between Venice and Germany.

During the Renaissance it was common for noble families to forge alliances through strategic marriages. These unions were often celebrated with the creation of new coats of arms that combined those of the husband and wife, and the newly combined heraldic symbols were applied to dozens of household objects, from carriages to cushions and everything in between. The Behaim Beaker was presumably commissioned



A glassmaking factory in Murano near Venice. Beginning in 1291, legal statutes restricted all glassmaking to the island of Murano.

By Louis Figuier - 1027010, CC BY 2.0,
<https://commons.wikimedia.org/w/index.php?curid=24958195>

by the Behaim family of Nuremberg, Germany, to celebrate the union of Michael IV Behaim and Katharina Locherin, who were married July 7, 1495. Hence the inclusion of the martyred St. Catherine of Alexandria and the archangel St. Michael: these were the holy namesakes of the bride and groom. Michael was a knight and civic official in Nuremberg, and Katharina was the daughter of a rich merchant who controlled the trade between Nuremberg and Venice, which may explain the beaker's existence.¹⁸ Custom-made in Venice, the beaker was shipped over 375 miles and across the Alps to Nuremberg—quite a feat in 1495.

Several small details evidence the ways in which the Venetian painter who enameled the beaker's surface was not familiar with Nuremberg heraldry. The painter was probably working from a pattern provided by the Behaims. What should be an eagle on the top of the crest has been made into a white, goose-like bird. The shield, too, is missing its cutout (called a bouche), and the helm lacks the breathing holes that are normally featured on Nuremberg-made versions of this coat of arms.

The decoration on the beaker's cristallo-grade transparent glass is notably ornamental, covering its whole surface while allowing the transparency of the object to remain legible via its blank areas. The style of this all-over decoration signals the luxury status of the glass it adorns by tapping into the then-current trend of *disegno*, the Renaissance-era fashion for pictorial charm in visual design. Writing in 1612, the Italian glassmaker Antonio Neri claimed, “it is more delightful, polite and sightly than any other material at this day known to the world...since from Glass there ariseth neither rust, nor taste, nor smell, nor any other quality.”¹⁹ The believed incorruptibility of glass associated with its functions in ceremonial dining recalls as well the period understanding that rock crystal—for which cristallo was named and oft associated—could reveal any poison. Clear, colorless cristallo was thought to bear many of the same magical properties.

While the Behaim Beaker is an excellent example of gilded and enameled Venetian cristallo, it also demonstrates how glass from Venice commanded attention abroad, connecting Venice to northern Europe during the Age of Discovery.

THE BENIN BRONZES: LOST-WAX CASTING IN AN AFRICAN KINGDOM

The Benin bronzes plaques are a corpus of more than 850 metal reliefs that once hung in the audience court of the oba (meaning “king” or “ruler” in Yoruba and Bini) of Benin. The Kingdom of Benin was located in present-day Nigeria, and the plaques, roughly the size of two sheets of paper and two inches thick, glorified the oba through ritualistic imagery. Beyond the plaques, which are roughly rectangular and mostly flat, the larger group termed “the Benin bronzes” also constitutes sculptures of figures and animals in the round, as well as objects made of ivory and coral. These objects were all elaborately decorated and delicately wrought by a mighty kingdom.

At its height in the fifteenth and sixteenth centuries, the Kingdom of Benin controlled an area of land about the size of New England with some two million inhabitants. Awed by Benin City, the kingdom’s



Bronze plaques from the Kingdom of Benin now on display at the British Museum in London.

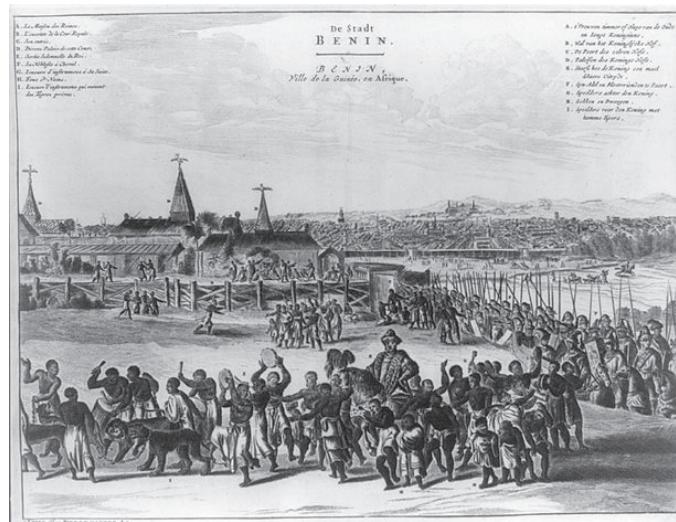
capital, one Dutch visitor declared that the metropolis was cleaner and more beautiful than any in Holland.²⁰ Trade with the Portuguese in the sixteenth century spurred the progress of metal casting in Benin during the rule of Oba Esigie and Oba Orhogbua. Although West Africans had invented the smelting of copper and

zinc and the casting of brass by the tenth century, they could not mine enough metal to supply Benin City's robust group of metal casters.

An imported product made up for the dearth of this precious resource. Made in the Low Countries, brass bracelets called manillas were brought to West Africa by Portuguese traders. Manillas circulated in the region as a kind of currency but could also be melted down to create works of pictorial art made of brass. In exchange for precious brass manillas, Portuguese traders bartered with the people of Benin for pepper, cloth, ivory, and enslaved persons.

African Lost-Wax Casting

Although they are colloquially known as the “Benin bronzes,” most of the plaques in this group of artworks are in fact made of leaded brass and produced by the lost-wax method of metal casting. Lost-wax casting has been practiced by nearly every civilization around the globe. In casting brass by the lost-wax method, the artist first molds a soft material such as clay into the desired shape and covers it with wax. A second coat of clay is then layered over the wax and attached with pins or other supports. The wax is then melted with high temperature water or another material and allowed to flow away, which leaves a hollow space between the two layers of soft material. Then the artist pours molten brass into this hollow space. After the metal cools, the clay is cut away, and the brass is now in the shape originally formed by the “lost” wax. It is ready for tooling, polishing, and any additional incising the metalworker may want to perform. This process is similar to the lost-wax casting methods developed



Depiction of Benin City in 1668 by a Dutch illustrator.

by Greek and Roman artisans, who made life-size sculptures of deities and other figures in bronze.

Lost-wax casting has been practiced extensively on the African continent for centuries. While scholars do not know how the method came to the region, it is certain that West African sculptors were casting brass with this method for centuries before the arrival of the first Portuguese explorers in 1484. Some of the oldest and most advanced bronze sculptures made in Africa date to the ninth century CE and are from a site called Igbo-Ukwu.²¹ In the Kingdom of Benin during the sixteenth century, the royal court of the oba supported specialist guilds. These masters in metalworking made the Benin bronze plaques, inheritors of a long tradition of lost-wax casting that stretched back to the medieval period.

SELECTED WORK: Benin Plaque with Oba, Edo Ethnic Group, Sixteenth to Seventeenth Centuries

Likely commissioned by Oba Esigie and his son Oba Orhogbua, the pictorial reliefs of the Benin bronze plaques depict courtiers and warriors honoring the oba, as well as abstracted renderings of animals. The plaques were made to adorn the halls of the king's palace in Benin City, a large complex designed around a series of atrium courtyards. When installed in the audience hall of the oba—likely in pairs on the vertical columns that supported the roof—the reliefs created a decorative program glorifying the oba by representing instances of his prestige, status, and achievements. These decorations reflected the structural order of Benin society, wherein all strength resided in the oba whose divinity and magical powers enabled him to link directly with the spirit world.

Though Benin bronze plaques today appear brown in color, when they were installed in the audience hall, they

would have been far lighter in color and gleamed in the light. Members of the royal household kept the metal panels polished to ensure they would reflect the sun and dazzle visitors. Court attendees made note of this striking feature, recalling that the plaques were glistening in the light entering the audience hall through the open atrium. With the Benin plaques attached to the columns in the hall, likely positioned behind and around the oba, the ruler would have cut an impressive figure. This is especially true considering that brass, their primary material, was at the time a medium of exchange in the Kingdom of Benin. To make decorative (and thus unusable) objects entirely out of a material used for currency was a decisive statement about the amassed wealth of the king and his court.

One surviving [plaque](#) shows what the audience hall probably looked like at the time, with depictions of courtiers and warriors on the plaques decorating the pillars. Hanging on all sides of the columns, the plaques would have created the impression that the pillars were of solid bronze.

Our selected work, the [relief](#) plaque with an oba dominating leopards, is one of many examples in which the ruler is shown in a position of absolute power over his world. With his distinctive beaded coral regalia, he is easily identifiable as the oba. Coral symbolizes both wealth, because of its association with the sea deity *Olokun*, and the oba's right to take life, because of its bloody color. His crown of coral beads, with its tall hat called an oba projection, further marks him as the supreme leader of Benin.

Holding a leopard in each hand, the oba is understood to be so strong as to easily dominate the fastest and most ferocious animals in the forest. The leopards are depicted wearing collars made of coral and adorned with small bells, suggesting that they have been tamed by the powerful man who holds them. The leopard was, as well, a politically restricted symbol and only associated with the oba, as the big cats were understood to be his imperial counterpart in the animal kingdom. The cats' coats are beautifully evoked with an intricate pattern of speckles and circular spots.

Around the oba's waist, two mudfish hang downward. Because the mudfish is an enterprising creature, able to endure long periods of drought by burrowing into the mud, the inclusion of this animal can be understood as emblematic of the oba's ability to metaphorically move between worlds—divine and earthly. Mudfish can also deploy an electrical charge and shock predators and prey who touch them. For the oba, this symbolic animal would have been understood as a representation of the man's own forceful and ordained leadership. This example is typical in its depictions of animals in African art as a statement of political and ritual power.

The composition is rigidly symmetrical—an aesthetic choice—and displays an impressive variation in depth of sculpting. The oba's head, for instance, is depicted in [high relief](#) (its forms raised high up from the surface of the plaque). In the background of the image, a river leaf motif is carved in [low relief](#). This extreme dichotomy in relief as well as the clarity and variety of the panels' decoration evidences a real mastery of the lost-wax method of metal casting.

This intensive attention paid to the ruler's head is by no means accidental. In this and other Benin bronze panels, the 1:4 ratio of head to body reflects a fundamental principle of African art and cosmology: the belief that one's destiny resides in the head. The head is emphasized because it was believed to be the seat of a person's intelligence and character. His features, too, are not purely naturalistic and instead take on symbolic intent. The oba's idealized face, for example, reflects his *ore inu* (inner head) and represents a romanticized type rather than his true physical appearance. All these elements—the rigid symmetry, emblematic animals, symbolic anatomy—come together to express the total power of this god among men.

The Benin Bronzes Today

Today, the vast majority of Benin bronze sculptures are not housed in their native homeland, present-day Nigeria. Instead, they are part of museum collections all over the world. This fact is the result of a spectacularly grotesque act of colonial violence carried out by British forces in February of 1897. Their raid was ostensibly launched in retaliation for the massacre of a British diplomatic mission to Benin earlier that year. The expeditionary force of 1,200 British soldiers who invaded the city of Benin murdered hundreds of Benin's citizens, who were armed with mere swords and muskets against the machine guns and mobile artillery of the British.

Following this attack, British forces packed hundreds of crates with the Kingdom of Benin's cherished cultural patrimony before a fire began, either deliberately or by accident. Centuries-old shrines, storehouses, homes, and burial places were destroyed. A critic writing today has likened this act of vandalism and plundering to an invading army capturing London, burning Buckingham Palace, and looting the whole of the National Gallery.²² Adding insult to injury, the Benin bronzes comprise the whole historical record of the region, as ancient Benin had no system of writing apart from the events recorded within their artworks. In our current moment, a staggering three thousand objects from Benin are in the possession of global museums. Due to the extent of British pillaging in 1897, the ownership of most of these objects is questionable.

In recent years, the story of the Benin bronzes has come to the forefront of an international conversation about the lasting impacts of imperialism and the need for justice. In 2007, a group of Western museum officials joined Nigerians in a “Benin Dialogue Group” to open discussions about repatriation—the return of these works to Nigeria. Progress was slow until 2020, when the resurgence of the Black Lives Matter Movement spurred change. Since then, the University of Aberdeen in Scotland, the Smithsonian Institution, the German government, and the Universities of Oxford and Cambridge have pledged to return all or most of their Benin bronzes to Nigerian authorities. These repatriated works are destined for a new museum in Nigeria, called the Edo Museum of West African Art. It is slated for completion by 2025.



A photograph of the interior of the oba's compound being burnt by British forces, with bronze plaques in the foreground and three British soldiers in the background.

However, the largest possessor of Benin bronzes worldwide, the British Museum, is unwilling to repatriate. Including the selected work in this resource guide, Benin Plaque with Oba, the British Museum holds some nine hundred Benin objects in its collection. Only a hundred of them are on view at any given time.

SECTION III SUMMARY

The Compass and the Full-Rigged Ship

- By the end of the fifteenth century, the ancient practices of sea navigation rapidly advanced in response to the needs of oceanic explorers.
- Invented in China, magnetic compasses had become the principal instrument for mariners navigating the open oceans by the late Middle Ages, replacing less reliable astronomical methods.
- The compass, though a small tool, forged a massive breakthrough, igniting the so-called “Age of Discovery,” when nearly every major European power sent explorers to gather knowledge about marketable goods in new lands and to claim them for their own. Also called the Age of Exploration, this period spanned the fifteenth to the seventeenth centuries, but its height was from 1492 to 1565.
- The early fifteenth century also saw the rise of the full-rigged ship, which connected the world via faster and cheaper trade routes and enabled the voyages of Vasco Da Gama, Christopher Columbus, and John Cabot.

Gutenberg's Printing Press

- Prior to the rise of the Internet, no technology has done more for the spread and democratization of knowledge than the printing press, which effectively connected the world through ideas.
- The roots of printing lie in the ancient Near East some five thousand years ago, where the technology of relief impressions pressed into clay would eventually spread to India and then China.
- In the second century CE, the Chinese invented paper, which provided a lightweight and light-colored vehicle for dark ink. By the ninth century, Chinese printmakers had established regular book- and print-making trades using wooden blocks carved in relief.
- By 1297, Wang Chen had produced the world's first mass-produced book by using moveable type made of wooden blocks.
- In Germany around 1440, Johannes Gutenberg's printing press adapted moveable type and preexisting presses to develop a mechanical press that could apply pressure to the inked surface of metal letter type and a print medium such as paper or cloth.
- By 1500, over a thousand Gutenberg presses were operating in Europe, and by 1600 they had created over two hundred million new books. With the newfound ability to inexpensively mass-produce books on every imaginable topic, revolutionary ideas and ancient knowledge were newly available to literate Europeans.

Printmaking

- In the arts, printmaking was already well established by the time Gutenberg's development of moveable type printing took off. The technique allows multiple copies of an image to be printed from a flat, carved block of wood or metal. The two primary examples of printmaking are woodcuts and engravings. As literacy rose and increased wealth created new markets for illustrated books, artists met the challenge of incorporating printed woodcuts or engravings into pages with letterpress text.
- Lighter, smaller, and more transportable than large-scale artworks, prints played an

incredibly important role in the transference of ideas and the spread of artistic knowledge and iconography, especially during the so-called "Age of Discovery."

Selected Work: *Melencolia I*, Albrecht Dürer, 1514

- Albrecht Dürer, a German artist of the Northern Renaissance, greatly advanced the technical and conceptual range of the print medium and promoted his graphic art with the astute skills of a businessman. He is one of the first artists to aggressively market his engravings and woodcuts to achieve fame and financial success across Europe.
- One of the artist's best known and most enigmatic images, *Melencolia I* is a depiction of the intellectual situation of the artist and is thus, by extension, a spiritual self-portrait of Dürer himself.
- Overall, the work can be interpreted as Dürer's declaration about the bittersweet nature of the artistic spirit and its relationship to the melancholic humor, creation, and hope.

The Invention of Linear Perspective

- The invention of linear perspective genuinely transformed the history of visual art. Also called "scientific perspective," this Renaissance-era technology was not so much a machine or tool, but rather a mechanical system for rendering the world more naturally. The geometrically based procedure projects the illusion of space onto a two-dimensional surface, allowing the flat picture plane to become a window into another world.
- Invented by the Italian architect Filippo Brunelleschi, linear perspective enables artists to determine, mathematically, the relative size of rendered objects to correlate them with visual recession into space using a horizon line, vanishing point, and orthogonals.
- The Renaissance-era rediscovery of perspective represents a sharp transition from the portrayal of space during the Middle Ages, when religious needs overcame the desire to depict objects illusionistically. As such, it was one early symptom of the slow secularization of culture: scientific thinking was beginning to overwrite spiritual belief.

- Combining mathematics, science, and vision, linear perspective effectively established a new way of seeing and conceptualizing the world. It rationalized sight, reflecting the emergence of modern science and its adoption at every level of society and culture. It also made possible scale drawings, maps, charts, graphs, and diagrams—exact methods of representation that could transfer knowledge with precision across and between distant lands. During this era of global trade, this techno-mechanical system was invaluable, laying the foundation for modern technology and science.

Selected Work: *The Annunciation*, Fra Filippo Lippi, c. 1450–53

- Fra Filippo Lippi's *The Annunciation* was commissioned to decorate the Palazzo Medici in Florence. It depicts the Annunciation of the Virgin Mary—the announcement of the immaculate conception of Christ—with the archangel Gabriel delivering the message to Mary.
- In this version of the Annunciation (a subject Lippi painted multiple times), a perspectival scheme defines the space. Lippi placed the horizon line and vanishing point in the composition's background and allowed the architecture of the garden to appear as visible orthogonal lines radiating out and forward, toward the viewer.
- While this work offers a good example of the effective deployment of linear perspective, its imagery maintains older traditions of Christian iconography, which prioritized religious content over realism.

Filippo Brunelleschi's Dome and Renaissance Architecture

- The dome of the Florentine Duomo was a great departure from the Gothic, Roman, and Byzantine buildings Brunelleschi studied. (He may also have studied Persian structures, but we cannot be sure.) These studies likely led to his invention of linear perspective. The dome was, and still is, a feat of engineering and has come to represent the inventiveness, piety, ambition, and skill of the Florentine Renaissance.
- Brunelleschi's design featured dual shells, a

system that may well have been inspired by Persian architectural practices, evidencing global trade, and the coffered dome of the Pantheon in nearby Rome. Instead of concrete, Brunelleschi's use of brickwork marks an advance in that building material by using a herringbone pattern to lessen the weight as the layers rise. The marked use of ribs and the pointed profile of the arches reflect the influence of Gothic architecture.

- Taken as a whole, Brunelleschi's architectural scheme for the dome of the Duomo reflects a bold, analytical plan that advanced modes of design based in antiquity and the Middle Ages.

The Advent of Oil Paint and Canvas

- The adoption of oil paint by European painters began with Early Netherlandish painting in Northern Europe. By the zenith of the Renaissance, oil had almost completely overtaken egg tempera paints in the majority of European painting studios.
- The advantages of oil for painting images are significant. The medium offers artists previously unmatched degrees of facility to fuse tones and colors, making it unique among fluid painting mediums. Allowing for a much higher degree of realism, oil paint solidified and honed the drive toward naturalism in the visual arts.
- In addition to oil paint, canvas proved a huge advance for the history of painting. Originally introduced in fourteenth-century Italy as a more affordable and more portable alternative to wood panel, canvas consists of strong, tightly woven fabric that is primed with a paint binder called gesso and stretched across a wooden frame. It is still the most common support for paintings today.

Selected Work: *Judith and her Maidservant with the Head of Holofernes*, Artemisia Gentileschi, c. 1623–25

- The realism in painting made possible by the advent of the oil on canvas medium gave rise to the Baroque style after the Renaissance waned.
- Working in Rome at the height of Baroque production, Artemisia Gentileschi is an early example of a woman artist who built

a successful career for herself in a society dominated by men. Oil paint enabled her to develop a highly naturalistic style featuring meticulous attention to detail that imparted a sense of drama and realism to emotionally fraught imagery. Lush fabrics, flesh, hair, and even blood—all wrought in the mesmeric precision of oil paint—heighten the theatricality and power of her paintings of strong women.

- Gentileschi did not shy away from violent subjects in her compositions and instead deployed female ferocity as a tool to heroize women protagonists such as the mythical Judith. In *Judith and her Maidservant with the Head of Holofernes*, Gentileschi's masterful use of oil paint brings the scene to life with its naturalism and depiction of a climactic moment of tension. The darkened lighting, vivid colors, and realistic textures of objects make the scene tense with the emotions of furtive haste and desperate secrecy.

The Invention of Cristallo Glass

- The invention of the technological process to produce cristallo glass around 1450 greatly advanced glassmaking and, by association, the domestic arts during the Renaissance period. Made only on the island of Murano outside Venice, cristallo was perfectly clear, colorless glass that quickly became a luxury tableware in high demand throughout Venice's markets in Europe and the Middle East.
- The new technology for producing cristallo required a former, a flux, a stabilizer, and a decolorizer. The former was a special silica imported from mainland Italy (quartz pebbles from the Ticino and Adige Rivers), and the flux was a plant ash called *allume catina* (imported from Syria and Egypt). Along with the stabilizer and the decolorizer (from the Piemonte region of Italy), cristallo was the product of not only the specialized knowledge carefully guarded by Venetian glassmakers, but also the dynamic trade alliances connecting diverse cultures.

Selected Work: The Behaim Beaker, Probably 1495

- Over time, Venetian glass makers developed extensive practices for decorating their glass

objects. One example is the *Behaim Beaker*, which depicts the Behaim family coat of arms alongside framed tableau images of Saints Catherine and Michael.

- The Behaim Beaker was presumably commissioned by the Behaim family of Nuremberg, Germany, to celebrate the union of Michael IV Behaim and Katharina Locherin, who were married on July 7, 1495. The martyred St. Catherine of Alexandria and the archangel St. Michael were included on the beaker because these were the holy namesakes of the bride and groom. Custom-made in Venice, the beaker was shipped over 375 miles and across the Alps to Nuremberg.
- The decoration on the beaker's cristallo-grade transparent glass is notably ornamental, covering its whole surface while allowing the transparency of the object to remain legible via its blank areas. The style of this all-over decoration signals the luxury status of the glass it adorns by tapping into the then-current trend of *disegno*.
- The Behaim Beaker is thus an excellent example of gilded and enameled Venetian cristallo. It also demonstrates how glass from Venice commanded attention abroad, connecting Venice to northern Europe during the Age of Discovery.

The Benin Bronzes: Lost-Wax Casting in an African Kingdom

- The Benin bronze plaques are a corpus of more than 850 reliefs that once hung in the audience court of the oba. At its height in the fifteenth and sixteenth centuries, the Kingdom of Benin controlled an area of land about the size of New England in present-day Nigeria.
- The kingdom of Benin was militarily and economically aggressive and fought its neighbors to control coastal trade with Europeans. Trade with the Portuguese, in particular, allowed the oba (the ruler) to import large quantities of brass. The oba himself controlled these trades, and was personally responsible for trading pepper, cloth, ivory, and enslaved persons for brass.

African Lost-Wax Casting

- Although they are colloquially known as the “Benin bronzes,” most of the plaques in this group of artworks are in fact made of leaded brass, produced by the lost-wax method of metal casting.
- The method uses a clay core and a wax coating placed in a mold. The wax is melted in the mold and drained out, and bronze poured into the space left, producing a hollow bronze figure when the core is discarded.
- Lost-wax casting has been practiced extensively on the African continent for centuries; the metalworkers who made the Benin bronzes were the inheritors of a long tradition of lost-wax casting that stretched back to the medieval period.

Selected Work: Benin Plaque with Oba, Edo Ethnic Group, c. 15th–16th century

- The pictorial reliefs of the Benin bronze plaques depict courtiers and warriors honoring the oba, as well as abstracted renderings of animals. The plaques were made to adorn the halls of the king’s palace in Benin City. When installed in the audience hall of the oba—likely in pairs on the vertical columns that supported the roof—the reliefs created a decorative program glorifying the oba by representing instances of his prestige, status, and achievements.
- The relief plaque with an oba dominating leopards is one of many examples in which the ruler is shown in a position of absolute power over his world. He is identifiable by his

clothing and headdress and holds two leopards with ease in a demonstration of strength. The leopard was understood to be the oba’s spiritual counterpart in the animal kingdom. The two mudfish that hang down from the oba’s waist are emblematic of the ruler’s believed ability to move between worlds—the divine and the earthly.

- In this and other Benin bronze panels, the 1:4 ratio of head to body reflects a fundamental principle of West African art and cosmology: that one’s destiny resides in the head.
- Taken together, the elements of rigid symmetry, emblematic animals, and symbolic anatomy express the total power of this god among men.

The Benin Bronzes Today

- Today, the vast majority of Benin bronze sculptures are housed in museum collections all over the world—a fact that is the direct result of an act of horrific colonial violence carried out by British forces in February of 1897.
- Over a thousand British troops invaded the city and killed hundreds of people who carried only muskets and swords (the British had machine guns) before looting the centuries-old collections of the royal palace.
- These objects were shipped to England and sold at auction. Many made their way into the collection of the British Museum, which currently possesses the Benin Plaque with Oba.
- Despite calls to repatriate their huge collection of Benin bronzes to Nigeria, the British Museum is unwilling to shift its stance.

SECTION IV

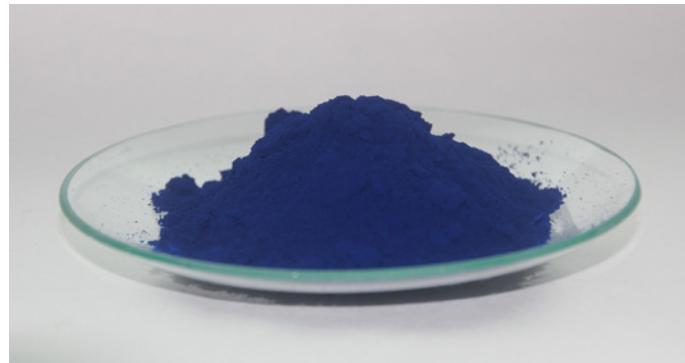
Scientific Innovations in Paint

PRUSSIAN BLUE: THE FIRST MODERN PIGMENT

As we learned in the previous section, the advent of oil paint and the adoption of canvas as the predominant medium for painters was a hugely important innovation in Western art history. Until the dawn of the Enlightenment and the development of chemistry in the eighteenth century, most colorants for oil paint were naturally derived. This meant that artists were limited to naturally occurring oxides, plants, minerals, or semiprecious stones for executing their compositions. That is until 1704, when the accidental discovery of a bright blue powder in an alchemist's laboratory in Berlin opened new possibilities for artistic expression. Named "Prussian blue" for its origin within the Prussian Empire, by 1710 the color's potential as an artistic pigment had been recognized, and it appeared on shelves at art shops in German cities.

For hundreds of years, fine blues that were chemically stable (meaning they would not fade when exposed to light) had remained a luxury item for painters. Ultramarine, an intensely saturated cobalt blue color, was one of the most expensive artistic pigments. Produced by grinding the lapis lazuli stone—mined from the mountains of Afghanistan—into a fine powder, ultramarine was generally reserved for use in religious paintings, specifically depictions of the Virgin Mary's clothing.

The discovery of Prussian blue, an accident that was the result of a simple error by German colormaker Jacob Diesbach, upended the market for blue pigments. Making a standard batch of cochineal red lake, which required iron sulfate and potash, Diesbach purchased his potash from an alchemist named Johann Konrad Dippel. In what scholars believe was an attempt to economize, Diesbach requested that Dippel give him a batch of previously used potash, but neither man



Sample of Prussian blue.

knew that it had been contaminated with animal fats. Diesbach was dismayed when his red lake came out extremely pale. When he attempted to concentrate it, the mixture turned purple, then deep blue.

Confused and lacking scientific knowledge, Diesbach asked Dippel for an explanation. The alchemist deduced that the blue color came from a reaction between iron and sulfate and the contaminated alkali. He was unable to conceive any further explanation, but in retrospect we know that the alkali reacted with Dippel's oil to make potassium ferrocyanide. This was then combined with iron sulfate to form the compound that chemists today call iron ferrocyanide, known colloquially by its pigment name, Prussian blue. Hence Diesbach's happy accident was the sort that characterizes many accounts of technological innovation. Setting out to make one thing, he ended up discovering what would eventually become the first synthetic pigment in the modern era. A boon to artists across Europe, it shifted the course of art history.²³

An early example of Prussian blue used in an oil on canvas composition is Antoine Watteau's *The Italian Comedians* from about 1720. Watteau used Prussian blue to color the lute player's silk stockings, as well as the cape spread across the shoulders of the figure dressed in gold. *Comedians* was completed around

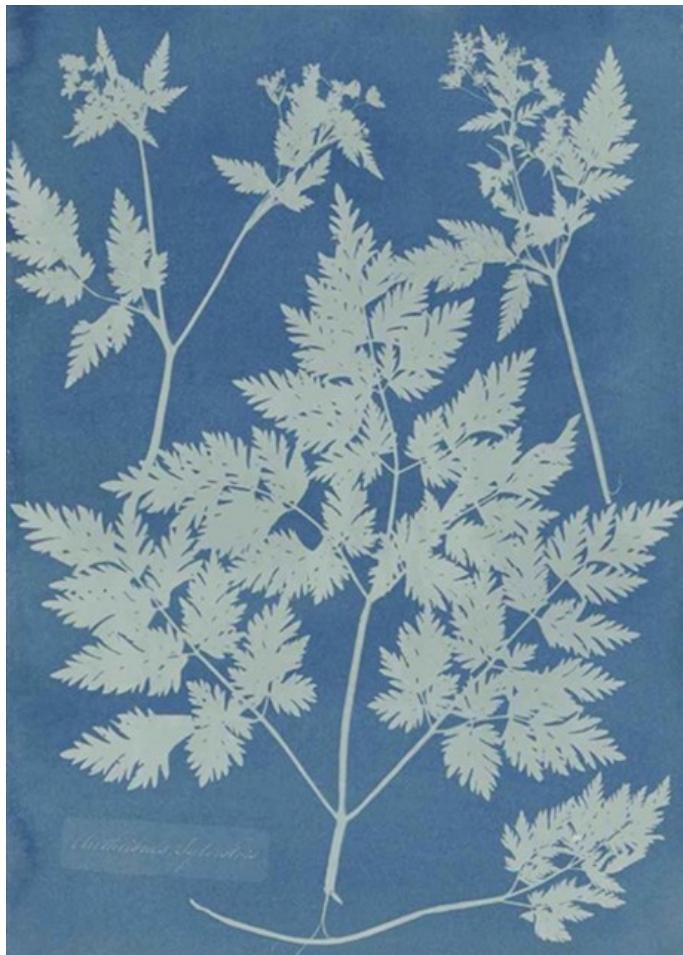


Antoine Watteau, *The Italian Comedians*, c. 1720.

National Gallery of Art, Washington, D.C.

1720, and at the time Prussian blue was still a novelty for artists—hence the rare and expensive powder was used only in two small details within the painting. But they are meaningful details. The musician and the actor who wear garments in Prussian blue lean in toward the central performer dressed in white, their lithe bodies curving inward to visually touch him (with the neck of the lute and an outstretched hand, respectively).

Non-toxic, stable, and just a tenth of the cost of ultramarine, the new blue spread rapidly throughout Europe, its dense tint making it ideal for rich Rococo scenes. By the time *A Girl with a Kitten* was completed in the first half of the 1740s, Prussian blue was being produced in manufacturing centers across Europe, making the pigment more available to artists. In this work, which has been attributed to Jean-Baptiste Perronneau, Prussian blue was used for the girl's vibrant dress and in the duskier, shadowed blue of the background. Perronneau was a French artist who specialized in portraits executed in pastels, a type of colored chalk applied to textured paper. Like many other works in pastel, *A Girl with a Kitten* evidences the muted contours, feathery textures, and soft colors



Anna Atkins, *Anthriscus Sylvestria*, c. 1854. Plant cyanotype using Prussian blue to achieve light sensitivity.

of the medium. As a dry powder, a pigment like Prussian blue could be mixed with nearly any binding agent—be it oil paint or chalk—to color paper, canvas, or another support.

But despite its positives, Prussian blue is not a perfect pigment. When mixed with other colors, the pigment becomes diluted, making it more sensitive to UV light. In the nineteenth century, Anna Atkins, arguably the first recognized female photographer, capitalized on these light-sensitive properties. She used the Prussian blue pigment to create a series of groundbreaking plant cyanotypes—an early precursor to the new technology of photography, discussed at length in the next section.

SELECTED WORK: Self Portrait in a Straw Hat, Marie-Louise-Elisabeth Vigée-Lebrun, 1782

The oeuvre of the most successful and well-known female artist of the eighteenth century, Marie-Louise-Elisabeth Vigée-Lebrun, features prominent passages of Prussian blue. Born in Paris to a father who made a modest living as a painter and who died when she was twelve, Vigée-Lebrun was initially denied access to the French Royal Academy in Paris because of her gender. Taking matters into her own hands, she learned from printed manuals, becoming largely self-taught and eventually gaining admission to the Academy.

In her teens she began painting portraits. But because she was not a member of a painter's guild or an academy, these portraits were deemed illegal. Authorities confiscated all her brushes and her artistic materials, forcing her to seek admission to the less prestigious Academy of St. Luke, where she exhibited in 1774. The following year, in a marriage of convenience, she wed Jean-Baptiste-Pierre Lebrun, a painter and prominent art dealer who gave her access to powerful contacts. Her exceptional talent, vibrant personality, and sophistication soon had her circulating among the aristocracy and the wealthy, and she became a favorite of Queen Marie-Antoinette, whose portrait she painted some thirty times beginning in 1778.

With their liveliness, intimacy, and colorful palettes, Vigée-Lebrun's portraits are typically labeled **Rococo** in style. Similar to the Baroque style, the Rococo dealt in lavish excess, sinuous lines, pastel colors, and gilt furniture. The word comes from the French for pebble, *rocaille*, which referred to the small stones and shells used to decorate grotto interiors in period gardens.

An important portrait by Vigée-Lebrun in the Rococo style that utilizes Prussian blue is one of our selected works, her *Self Portrait in a Straw Hat* from 1782. She stares out at the viewer with confidence, wearing fine clothing and holding her brushes and an artist's palette in her left hand. The kidney-bean shaped wood sheet is dotted with globs of paint, and the brushes, with their colored bristles, show signs of recent use. One prominent paint color on her palette is Prussian blue, which is echoed in the cornflower included in the band of flowers around her hat and in the blue sky of the background. The color emphasizes the relaxed and naturalistic quality of the portrait, with the blue adding a sense of serenity.

Art historians have identified the pose she adopts in her self-portrait as a copy of Rubens's *Portrait of Susanna Lunden*, which was known in the eighteenth century as *Le Chapeau de Paille (The Straw Hat)*. But the subject of Rubens's picture does not, in fact, wear a hat made of straw: it is actually made of felt. In a cheeky reference, Vigée-Lebrun improves on Rubens's original by painting herself in a hat truly made of straw. Her memoirs confirm the connection between *Self Portrait in a Straw Hat* and its Rubenesque antecedent. Of the Rubens portrait Vigée-Lebrun wrote:

This painting delights me and inspired me to make my own portrait in Brussels in search of the same effect. I painted myself wearing a straw hat with a feather and a garland of wild flowers, and holding my palette. When the portrait was exhibited at the salon, I dare say it greatly enhanced my reputation.²⁴

The citation of a popular Old Master painting was a calculated bid to get viewers to see her as *both* a beautiful woman *and* a talented painter in the great tradition of Rubens. Whereas Rubens' portrait offers up a woman and her voluptuous body as an object to be gazed upon, Vigée-Lebrun's self-portrait turns the tables on this standard dichotomy. She instead looks directly back at us with the agency and power born of authorship and self-determination.

In the years leading up to the French Revolution in 1789, Vigée-Lebrun built an incredibly successful career as a society portraitist, particularly at Versailles. As the family breadwinner, she worked hard to

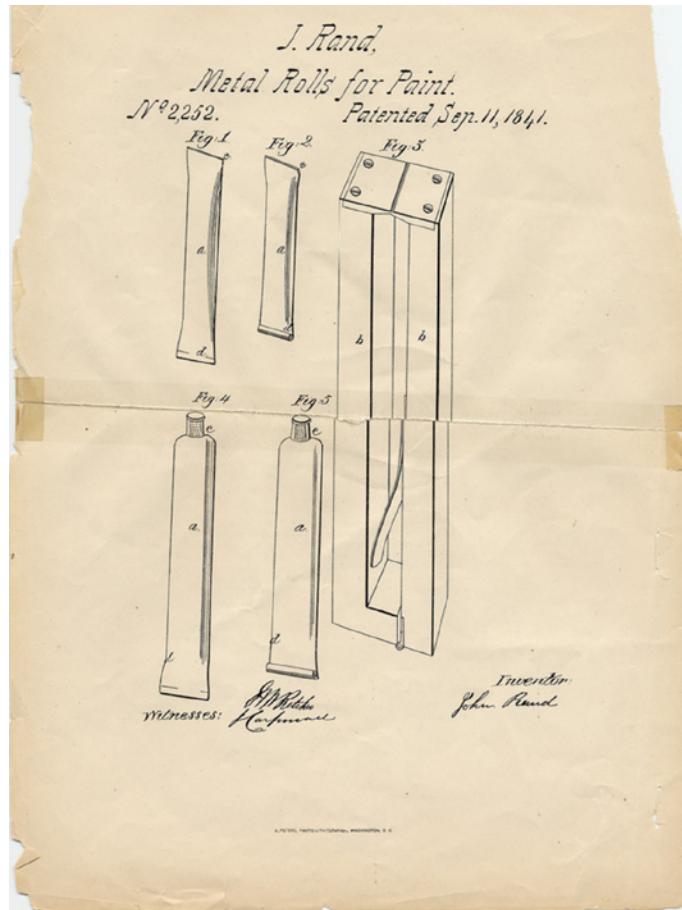
support her husband and daughter and resented her spouse because he pocketed her earnings and, as she said, “squandered” this hard-earned money. She eventually left him; their marriage was dissolved in 1794. Her independence, self-reliance, and drive to overcome the lack of opportunities afforded to women, not to mention her prodigious talent as a painter, taken together make Elisabeth Vigée-Lebrun a truly noteworthy force in the history of art.

MASS-PRODUCED TUBED PAINT AND THE IMPRESSIONISTS

Impressionist painting revolutionized the visual arts at the end of the nineteenth century. With its bright colors, emphasis on the shifting qualities of light in nature, and sketchy aesthetic, Impressionism offered a bold new way of seeing the world. These visual innovations depended in large part upon the physical qualities of oil-based paint—a material that saw enormous advances during the Scientific and Industrial Revolutions. As revolutionary as Prussian blue proved to be, it was a mere shadow compared to the explosion of available colors in the nineteenth century. With the wide-scale, deliberate invention of synthetic pigments, the number of paint colors available to artists expanded significantly, completely upending the limits of the artist’s palette. At the same time, paints also became more portable and long-lasting with the advent of the metal paint tube.

For the Impressionists, the natural world was alive with magnificent colors—complex hues that could not be captured with the traditional pigments found in oil-based paints. From their perches at the edges of fields and the benches of rowboats, they saw the outdoors in a fabulous kaleidoscope of endlessly diverse hues. Wanting to record these richly prismatic landscapes in the vibrating colors they witnessed, Impressionist painters moved outside to paint *en plein air* (French for “in the open air”). Plein-air painting allowed artists to closely observe the minute changes of natural lighting as sun and clouds moved shadows across a landscape. Claude Monet, the preeminent painter of the Impressionist movement, would work several canvases at once, trying to capture a precise moment in the day’s illumination.

To capture this “vibration of color” as the French poet Jules Laforgue called it, the Impressionists turned to a new—and newly lustrous—group of synthetic pigments made possible by the Scientific Revolution.²⁵ Paint pigments had remained nearly unchanged from



John Goffe Rand's patent, Improvement in the Construction of Vessels or Apparatus for Preserving Paint, &c., submitted September 11, 1841.

John Goffe Rand papers, Archives of American Art, Smithsonian Institution

the Renaissance until the 1770s, when developments in the field of chemistry laid the groundwork for world-changing advances in materials science. In 1789, for example, the French chemist Antoine Lavoisier listed thirty-three known elements (including oxygen and hydrogen). Over the next sixty years, twenty-nine more elements were discovered to nearly double the list (adding, for example, titanium, aluminum, and potassium). It should come as no surprise, then, that this period saw an explosion in the production of new pigments for artists, such as chrome yellow

and emerald green. Following centuries of very little innovation in which painters relied on naturally available materials—like reds and ochres derived from rocks mined from the earth—the explosion in new colorants revolutionized the kinds of paintings artists could make.

Newly mechanized processes for producing artists' paints also expanded the possibilities of artistic creation. Starting in the 1740s, pigments were crushed between mechanized stone rollers in horse-powered "paint mills." By the 1820s, the mill wheels were driven by steam. But hand grinding benefited from the grinder's skill and judgement, and initially the mechanically ground products were rather poor. It was not until 1836, when the kinks had been worked out, that Parisian color merchants began to use mechanically ground pigments for the high-quality oil paints artists demanded.²⁶

Another major innovation in paint supplies was the adoption of the collapsible metal tube, invented in 1841 by an American portrait painter named John Goffe Rand. Like many artists, Rand struggled to keep his oil paints from drying out before he could use them. At that time, the most common mode of paint storage was a pig's bladder sealed with string. An artist would prick the bladder with a tack to get at the paint, but there was no way to completely plug the hole afterward and bladders didn't travel well, frequently bursting open. In March of 1841, Rand took out a patent on "metallic collapsible tubes." Made from tin and sealed with a screw cap, Rand's collapsible tubes extended the usability of this precious and expensive material, did not leak, and could be repeatedly opened and closed.

Ultimately, this new technology transformed how artists painted. Tubed paint allowed artists to take supplies outdoors and paint *en plein air*—directly from nature—rather than working in a studio from sketches. The famed Impressionist painter Auguste Renoir even went so far as to declare that "without paints in tubes,



William Trost Richards' Lefranc brand oil paint tube, c. 1890s.

Chrysler Museum of Art

there would have been no Cézanne, no Monet, no Sisley or Pissarro, nothing of what the journalists were later to call Impressionism."²⁷

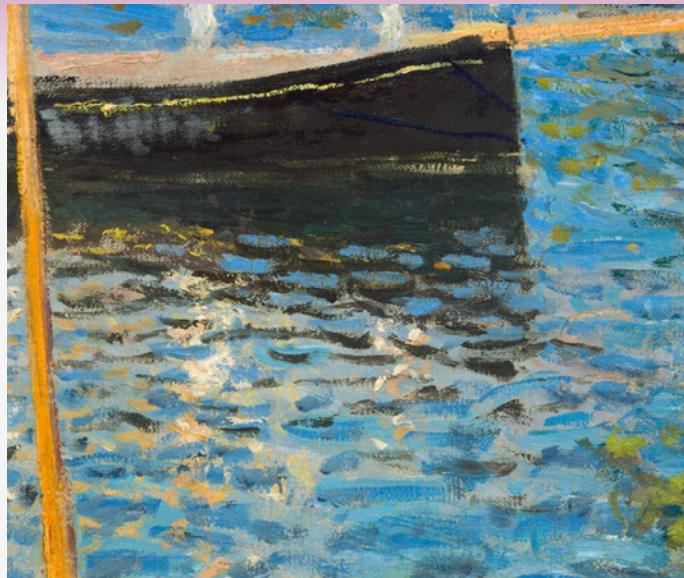
Because oil paint could be squeezed straight from the tube with ease, metal paint tubes also initiated the shift to creating the *impasto* effects that were characteristic of many Impressionist paintings. (The term *impasto* comes from the Italian verb "impastare," meaning to knead or to paste, and refers to the technique of thickly laying paint onto the canvas, so that it stands out from the surface.) Furthermore, the thick consistency of paint in tubes led to artists using stiff brushes that left textured marks on the surface of the canvas. Finally, newly patented folding easels helped artists to become more mobile, allowing any field or riverbank to become a useable studio space.

This mechanization and commercialization of artists' supplies effectively distanced painters from their materials. Whereas in the past artists would collect their own raw materials, crush them to a fine powder, and mix them in a liquid binder before spreading them on a canvas, after the onset of the Industrial Revolution artists could easily purchase pre-mixed paint in portable tubes. By the twentieth century, this trend would reach its zenith with the American Abstract Expressionist painter [Jackson Pollock](#), whose canvases employed a new type of synthetic paint made of a plastic called acrylic.

SELECTED WORK: *The Bridge at Argenteuil*, Claude Monet, 1874

In 1874, the year of the first Impressionist exhibition, Claude Monet painted the Argenteuil Bridge seven times. In the version that is our selected work, Monet captures the brilliance of light reflecting off water on a summer day. From a distance, the sketchy brushstrokes blend together to form a view of the Seine River with the boats that attracted pleasure seekers to Argenteuil, a picturesque suburb of Paris.

Up close, *The Bridge at Argenteuil* presents a great variety of visible brushstrokes. The texture of these marks is tailored to the objects they depict. The sky and clouds in the upper register of the frame, for example, are rendered in smooth, soft strokes of delicately applied paint. The vertical and horizontal geometries of the bridge, in contrast, are emphasized by firm outlines and linear brushstrokes, many of which are visible. The trees present areas with thicker, rougher strokes. And the water's dazzling motion as it reflects the sunlight is conveyed by choppy singular strokes of Prussian blue, cerulean, ochre, mauve, and white. These broken strokes manage to be both feathery and firm, lending the water's glossy surface the impression of motion and even mystery.



Detail of Monet's The Bridge at Argenteuil.



Michel Eugène Chevreul, Presentation of a way to define and name the colors, 1861.

The effects of light on the masts and their reflection in the blue water introduce the optical play of complementary orange and blue, a color harmony accentuating the pleasing feel of the painting's subject matter. The strategic use of **complementary colors** was a key philosophy in Impressionist color theory, which was founded on the scientifically based color theories of French chemist Michel Eugène Chevreul. As his [color wheel](#) of 1861 demonstrates, complementary colors are opposite one another on the circular diagram: red and green, violet and yellow, blue and orange. If two complementary colors are placed next to each other, they intensify one another. Place a pure red next to a pure green, and the red becomes redder and the green greener, the energy of each color escalating to the point where they seem to vibrate and pop. It was in this way that contemporary color theory helped Impressionist painters to enhance the perceived brightness of their paintings.

Striving to capture the fleeting effects of light and atmosphere on the landscape, Monet advised the

American artist Lilla Cabot Perry, “When you go out to paint, try to forget what objects you have before you, a tree, a house, a field or whatever. Merely think here is a little square of blue, here an oblong of pink, here a streak of yellow, and paint it just as it looks to you, the exact color and shape, until it gives your own naïve impression of the scene before you.”²⁸ By endeavoring to paint anew—as if seeing the world for the first time—Monet and his fellow Impressionists forged a new path forward into modernity.

SECTION IV SUMMARY

Prussian Blue: The First Modern Pigment

- Before the dawn of the Enlightenment brought with it the development of the field of chemistry, artists were limited to naturally occurring oxides, plants, minerals, or semiprecious stones for executing their compositions.
- In 1704, the first synthetic pigment was discovered by accident in an alchemist’s laboratory in Berlin. Named “Prussian blue” for its origin within the Prussian Empire, the new bright blue pigment was a boon for painters, who had previously limited their use of blue in paintings due to its high cost.
- Antoine Watteau was one of the first artists to incorporate Prussian blue into his paintings. The pigment is made feathery and light in his compositions, adding to the dreamy romanticism of many of his works.
- Over time, the pigment became more readily available and was incorporated into artworks in other mediums like pastel and watercolor despite its sensitivity to light, which could cause it to fade.

Selected Work: *Self Portrait in a Straw Hat*, Marie-Louise-Elisabeth Vigée-Lebrun, 1782

- The portraits of the most successful and well-known female artist of the eighteenth century, Marie-Louise-Elisabeth Vigée-Lebrun, feature prominent passages of Prussian blue.
- Working in the Rococo style, Vigée-Lebrun’s *Self Portrait in a Straw Hat* is a billboard advertising the artist’s talents as a painter and her successful career, which was earned in spite of her initial rejection by the Royal Academy because of her gender.
- The pose of the picture directly references one

of the best-loved portraits of the day: Rubens’s *Portrait of Susanna Lunden*. The citation of this popular Old Master painting was a calculated bid—to get viewers to see her as *both* a beautiful woman *and* a talented painter in the great tradition of Rubens.

- The presence of Prussian blue in the work underlines the artist’s air of calm authority, born of authorship and self-determination.

Mass-Produced Tubed Paint and the Impressionists

- The bold, bright colors, loose brushwork, and emphasis on the shifting qualities of light in nature that define Impressionist painting of the late nineteenth century depended in large part upon the invention of the metal paint tube and the greater availability of new synthetic colors.
- Wanting to record the vibrant colors they witnessed outdoors, Impressionist painters painted *en plein air*, which allowed artists to closely observe the minute changes of natural light. The collapsible metal tube, invented in 1841 by an American portrait painter named John Goffe Rand, allowed paints to be newly portable and long-lasting, meaning artists could more easily carry them outside. Because oil paint could be squeezed straight from the tube with ease, metal paint tubes also initiated the shift to creating *impasto* effects characteristic of many Impressionist paintings.
- New brushes, the mechanization of the process for producing artists’ paints, and the invention of the portable easel rounded off a host of new technologies allowing Impressionist painters to turn any field or riverbank into a useable studio space.

Selected Work: *The Bridge at Argenteuil*, Claude Monet, 1874

- Painted in the year of the first Impressionist

- exhibition, *The Bridge at Argenteuil* is one of many compositions in which Monet painted the Argenteuil Bridge. His focus in this iteration is to capture the brilliance of light reflecting off water on a summer day.
- The composition offers a great variety of visible brushstrokes; their textures are tailored to the objects they depict.
 - The strategic use of complementary colors—like red and green, blue and orange—reflects a key philosophy in Impressionist color theory. Informed by the nineteenth-century scientifically based color theories of French chemist Michel Eugène Chevreul, Impressionist painters used complementary colors to enhance the perceived brightness of their paintings.

SECTION V

The Advent of Photography

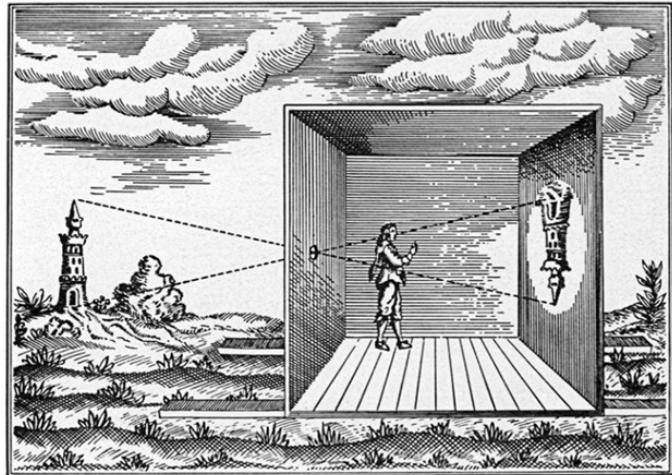
Photography was one of the most important technological advances in the history of image-making. Not only is the camera a recording device capable of scientifically documenting the world, but it also holds the potential to be an interpretive vehicle, allowing its users to access new modes of perceiving and understanding reality.

THE CAMERA OBSCURA

The world's first "camera" was not really a camera at all—at least in the way we think about the technology today. Called a **camera obscura**, this optical tool was used to copy the observable world and to communicate visual information in an unbiased manner. From the Latin for "dark chamber," in its earliest iteration a camera obscura was a darkened room in which a tiny opening in one wall acted like a lens, focusing an upside-down image of the scene outside onto the opposite wall. Often used as a drawing aid to artists and draughtspeople, cameras obscura also appealed to other professionals who wanted to convey visual data in an objective manner. Biologists, botanists, and geologists are just a few examples.

Known since the time of Aristotle and the Chinese philosopher Mozi, the room-sized chamber of the camera obscura was made smaller and portable over time. It was equipped with lenses and constructed with an internal mirror so that the upside-down image was righted and could be traced on a piece of paper placed on a translucent glass plate installed in the top of the device. Like other machines made to aid in drawing projections, the camera obscura did not encourage imagination or personal style, producing stiff, formal images in the style of Thomas Sandby's drawing of Windsor.

As an optical tool, the camera obscura was a technology that helped begin the process of mechanizing sight. But it was not until the nineteenth century that it would play



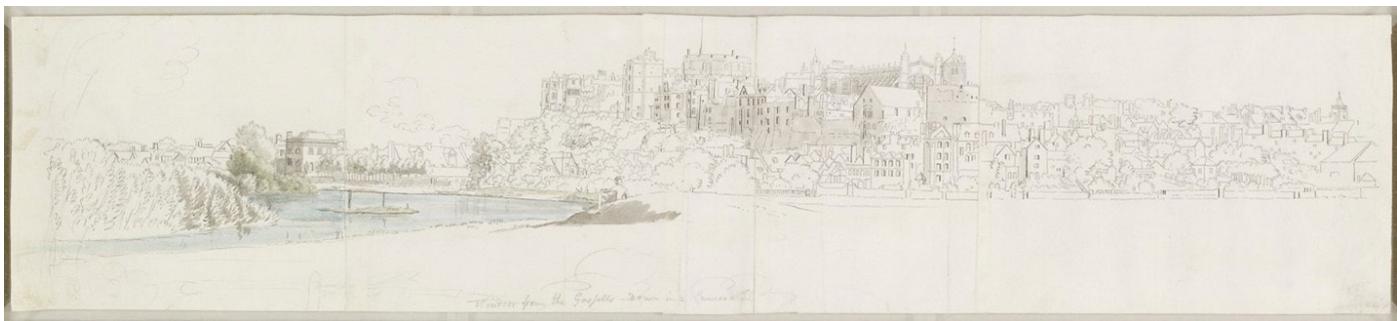
Early illustration showing the function of a camera obscura, Latin for "dark chamber."

a key role in photography's invention.

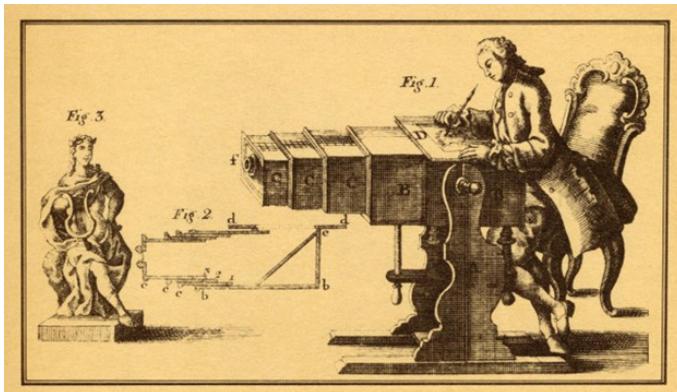
EARLY EXPERIMENTS IN FIXING AN IMAGE

The basic ingredients of photography—a light-tight box, lenses, and light-sensitive materials—were well established for hundreds of years before they were combined in the form of the photograph. In fact, if the invention of photography had depended solely on the availability of supplies, it even could have been a Renaissance-era invention. But before the end of the eighteenth century, imagining the photographic process was difficult, if not impossible. Commenting on what seemed like the overnight development of photographic technology, in 1859 the American essayist Oliver Wendell Holmes said, "in all the prophecies of dreaming enthusiasts, in all the random guesses of the future conquests over matter, we do not remember any prediction of such an inconceivable wonder...No Century of Inventions includes [photography] among its possibilities."²⁹

Despite the slow development of the technology,



The English artist Thomas Sandby used four pieces of paper attached together to trace a panoramic view of the city of Windsor from the projected image of a camera obscura. Note the slightly robotic linearity of the image, with its absolute rendering of architectural perspective and lack of any atmospheric effects like clouds.



Georg Brander, Table Camera Obscura, 1769, engraving.

many scientists and inventors spent decades tinkering with different methods for capturing an image on a flat surface using light-sensitive materials. It can even be said that there was no singular instance of photography's "invention." Rather than the regular and progressive history that has been accepted over time, the history of the first photographs does not fit into any progressive narrative of experiments building to a moment of final, conclusive success. We could even describe this period as the invention of multiple "photographies" since several different image-making methods were created simultaneously across the globe.

In 1830s Brazil, the French artist and cartographer Antoine Hércules Romuald Florence developed a technique for printing that successfully utilized light-sensitive materials to copy written documents. Covering glass plates with a dark mixture of gum arabic and soot, he scratched designs on the darkened plates and placed them on paper made light-sensitive with a treatment of

silver chloride, which darkens in the presence of light. The silver chloride's light sensitivity could then be neutralized with an application of ammonia solution, which stopped the darkening action. By 1832, Florence was employing this technique to use sunlight to print images of diplomas, tags, and labels, calling his method *photographie*, from the Greek for "light" and "writing."

As we will see, Louis Daguerre's 1839 method for taking remarkably detailed photographs of the world far outstripped Florence's experiments in South America. And yet, Florence's advances are remarkable regardless. Scholars have theorized that because he was working in Brazil and was thus removed from urban centers with easy access to cutting-edge science, he had to be more inventive. Unconventional thinking of this sort, combined with practical need and problem solving, has been a hallmark in technological advances throughout history.

In England, enthusiastic amateur scientists Thomas Wedgewood and Humphry Davy conducted similar experiments in light-writing, but without Florence's success in fixing the captured image via a chemical process. Working in the last decade of the eighteenth century, the pair tried to fix the image of an object's shadow on flat sheets of paper and leather, which had been made light-sensitive by immersion in a silver nitrate solution. But unknown to them, silver nitrate was not sufficiently light-sensitive to hold the light-formed images without a fixing agent to halt development. Wedgewood died in 1805 before he could witness the world's first permanent image written with light.

SELECTED WORK: View from the Window at Le Gras, Nicéphore Niépce, 1827

Looking for ways to develop new inventions he could later patent and capitalize on, beginning in 1816 the French amateur scientist Nicéphore Niépce started experimenting with images. He first used a light-sensitive paper coated in silver chloride solution. Exposing the treated paper within a camera obscura, he found the image too indistinct. Nor could he find a way to halt the action of the light and fix the image to the paper after exposure. Moreover, the tones of the image were reversed: dark became light, and light became dark, to create what was later known as a negative. Niépce tried, without success, to use the negative as it is used today—that is, he tried printing it to create a positive image, in which the tones are re-reversed and thereby corrected.

Motivated by a growing demand for affordable pictures, years of experimenting led Niépce to attempt to copy engravings using sunlight. In 1822, he saturated an engraving with oil to make it more transparent. He then placed it on a pewter plate that had been coated with bitumen of Judea, a substance known to harden when exposed to light. After exposure, the areas beneath the dark parts of the engraving remained soft while those beneath the light parts of the engraving hardened. He then rinsed the plate with lavender oil to wash away the soft areas. What remained was an engraved plate. Niépce then etched the metal plate's grooved areas further by immersing it in acid and inked and printed the plate on paper.

Because this process proved much more successful than his earlier experiments in silver chloride, in 1827 he repeated the procedure with a similarly prepared plate. He placed it in a portable camera obscura, which he positioned on a window ledge at Le Gras, his estate near Chalon-sur-Saône in eastern France. After an exposure time of about eight hours, he removed the plate from the inner chamber of the camera obscura and washed it to remove the loosened areas of the pewter plate where the bitumen of Judea had received less light. The resulting plate contained a blurry but visible negative of the scene outside the second-story window, looking out over the neighboring buildings to the landscape beyond. Niépce took his plate-printed image (which was reversed laterally—left to right) and exposed it to iodine fumes. The iodine did not fully reverse the tones, but it did create greater contrasts.

In essence, Niépce's eight-hour exposure on a pewter plate was the first direct positive image. As the name implies, a direct positive produces a photograph without a separate negative. This means that the plate was physically exposed to the scene that it depicts. This also means that the image could not be reproduced. Though not completely stable, *View from the Window at Le Gras* is today considered the world's oldest surviving permanent photograph.

Despite its hazy obscurity, the image still depicts an upper story of the Niépce residence that served as a pigeon house on the left side of the image, and, in the center, a slanted roof of a barn. Because the picture was exposed for about eight hours while the sun changed position, sunlight appears to be shining on the roof and both ends of the buildings.

THE DAGUERREOTYPE

Though Niépce was the first to create a stable and lasting image within the darkened box of a portable camera obscura, it was the Frenchman Louis Daguerre who developed a photographic method to reproduce the world in more detail—a method that, most important of all, could be commercialized. Daguerre began collaborating with Niépce in 1829, experimented

with shortening exposure time, and eventually arrived at a photographic process he humbly named the “Daguerreotype.” It would become the globe’s first widely successful and commercially available photographic form.

After collaborating with Niépce until Niépce’s death in 1833, Daguerre, by 1835, had focused on a new



Daguerreotype camera.

objective: to create and develop a **latent image**, meaning an image that was registered on the surface of the photographic plate during exposure, but was invisible to the naked eye before further chemical processing. By treating the exposed silver plate with mercury fumes, he could make the latent image become visible—as if by magic.

The new technique not only produced a sharper and more refined picture, but it also cut the exposure time down from several hours to around four or five minutes. To make a **daguerreotype**, a copper sheet plated with silver was given a high polish. This “plate,” as it was called, was placed with the silver side down over a closed box containing iodine. The iodine fumes fused

with the silver to create silver iodide, which is light-sensitive. The plate was then fitted into a specialized camera obscura, and a lens in the box was opened to expose the plate to light. After an exposure time of a few minutes, the plate with its latent image was placed into a special box and exposed to mercury fumes, which blended with the silver to produce a visible image. The still light-sensitive image was then washed with a solution of sodium chloride (table salt), which halted development, and then rinsed again with water.

Daguerre vastly underestimated the power of the new technological process he had invented. He thought the daguerreotype would be used by the “leisured class” to take renderings of their country houses. To his mind, photography’s potential was as a quaint hobby that required very little effort; “the little work it entails,” he wrote, “will greatly please the ladies.”³⁰

But while Daguerre had little clue that photography would change the course of history, he did understand that because the ingredients of the process were so simple and readily available, the technique would be copied, and quickly. So instead of attempting to take out a patent on the process, he made an agreement with the French government. In exchange for a lifelong pension, Daguerre would make the daguerreotyping process available to the world in a public gesture of goodwill from France to the globe.

SELECTED WORK: *Frederick Douglass, c. 1855*

After some revision to shorten the exposure time to less than a minute, Daguerre’s invention swept across the globe, giving rise to a booming portrait industry, particularly in the United States. Mere weeks after its announcement by the French government in 1839, the American artist and inventor Samuel Morse brought the daguerreotyping process to the United States. Soon every city in the country had its own photography studio offering daguerreotype portraits at prices affordable to middle-class sitters. Each offered low prices, standardized packages (poses, mats, cases), familiar props, and quick delivery.

Marketed as family keepsakes, these photographs were intrinsically tied to the commercialization of the image and the consumption of objects. Americans loved the miniature portraits with their shiny, mirror-like surfaces. The infinitely detailed pictures were drawn by light and captured in a chemical process that drew comparisons with alchemy, magic, and the occult. Today, daguerreotypes retain their detail and shine: they are not light sensitive, nor do they fade. Even their tones and shades are more accurate to nuance, notably depicting sitters with darker skin tones with more accuracy compared to later photographic processes.

In our selected work, a daguerreotype portrait of American abolitionist Frederick Douglass, the man stares stoically back at us, his brow bunched in concentration, his dark eyes clear and bright. Douglass was born into slavery in Maryland, but he escaped to the North when he was in his early twenties. He became

an incisive writer and orator and an author of influential antislavery tracts. Dressed in a fashionably stiff high collar, cravat, and black coat, with his hair carefully brushed back from his forehead, Douglass presents himself here as a stylish and refined gentleman. He is, quite literally, miles from the enslaved man he once was.

For Douglass, the key strength of the daguerreotype was its objectivity. He felt that he would never receive “an impartial portrait” from a white painter. But a camera would record reality precisely as it appeared. In 1849 Douglass wrote,

Negroes can never have impartial portraits, at the hands of white artists....Artists, like all other white persons, have adopted a theory respecting the distinctive features of Negro physiognomy...They associate with the Negro face, high cheek bones, distended nostril, depressed nose, thick lips, and retreating foreheads. This theory...leads [the white artist] to distort and exaggerate those peculiarities, even when they scarcely exist in the original. The temptation to make the likeness of the Negro, rather than of the man, is very strong.³¹

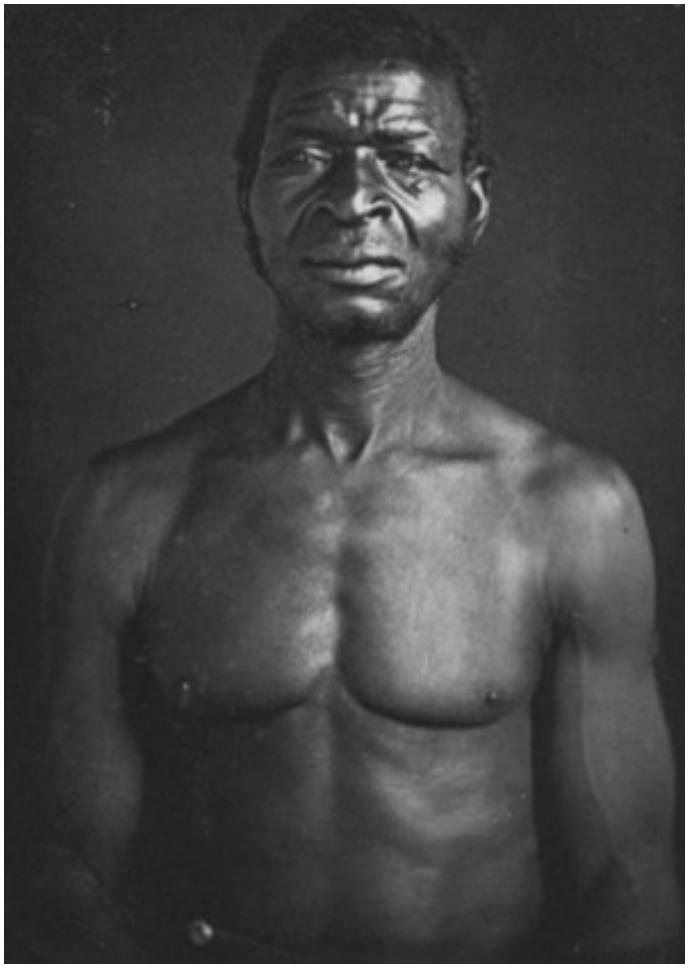
Because the photograph was “written by light” and thus removed from the biases of the human hand, Douglass, along with many of his contemporaries, saw the image as a direct index of the world seen through the camera lens. It was because of this truthful directness that the abolitionist saw the technology as a way to fight the prejudices found in racial caricatures and stereotypes.

With this confidence in the new image-making medium, Douglass had himself photographed repeatedly. It is astonishing for most readers to discover that Frederick Douglass was the most photographed person of the nineteenth century. He sat for the camera more than 160 times. (The American army officer George Custer came close with 155 sittings; Abraham Lincoln only made it to 126.) Douglass understood the power of images to shape and direct attention and define political narratives, and he manipulated the medium to his own ends.

In his photographs, Douglass demanded an unimpeded visual ground—no props allowed, unlike fellow abolitionists Harriet Tubman and Sojourner Truth—and he refused to smile and thereby play into the “happy slave” stereotype. His ever-serious expression was an indication of the fierce conviction he had for the project of abolition. In this way, Douglass used photography to disrupt negative caricatures of African Americans by presenting himself as an intellectual and a human being, thus challenging the grounds upon which slavery was based.



An additional view of the selected work. Early daguerreotypes were treasured portraits in miniature—small enough to be held in the hand, these metal-plate photographs were installed in velvet-lined cases that could be carried in a pocket.



Daguerreotype by J. T. Zealy, Jack (driver), Guinea, 1850.

Peabody Museum of Archaeology & Ethnology, Cambridge, Massachusetts

PHOTOGRAPHIC PORTRAITURE: DEMOCRATIZATION AND CONTROL

Frederick Douglass had great faith in the power of photography to level society's inequalities, calling it the most "democratic" medium. "What was once the exclusive luxury of the rich and great is now within reach of all," he wrote. Even the humblest of servants, he said, "may now possess a more perfect likeness of herself than noble ladies and even royalty, with all its precious treasures, could purchase fifty years ago."³²

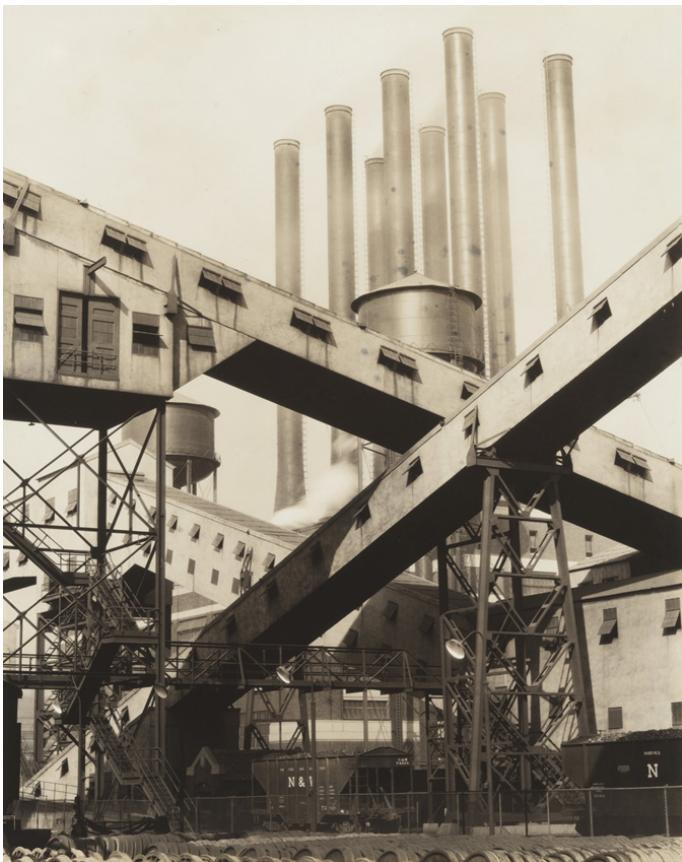
But while photography did democratize portraiture to allow middle- and lower-class people to hold onto images of their ancestors, it was not necessarily the great equalizer Douglass hoped it would be. Photography was also used for more nefarious purposes. In its perceived objectivity and precision, it was employed as a record to capture the faces of

immigrants and criminals, a tool wielded for societal control and surveillance.

It was also used to reinforce arguments against the abolition of slavery, and in favor of the supposed inferiority and inhumanity of human beings with darker skin tones. This was, of course, in direct opposition to Douglass's hopes. At Harvard University in 1850, for example, Louis Agassiz, a Professor of Zoology, commissioned the photographer J. T. Zealy to take front, side, and back views of African-American men and women enslaved on plantations in the Carolinas. The professor had the daguerreotypes taken in the name of science: Agassiz wanted proof supporting his theory of polygenesis. This false theory posited that African peoples were not direct descendants of the world's first humans (i.e., Adam and Eve), but instead the offspring of a second—inferior—creation. Figures like Agassiz deployed polygenesis as a "science" to justify the social systems of white supremacy, racism, and slavery.

Zealy, working under Agassiz, photographed different human "types" as anthropological "specimens." While these terms are disturbing when applied to human beings, still more unsettling are the images that remain from the Zealy-Agassiz project, which stand today as some of the most haunting and painful images to be made in the era of the daguerreotype. The enslaved people who look back at us were forced to be stripped partially naked and laid bare before the camera. Visible are the whip marks, scars, and other disfigurements that attest to their survival of slavery's brutalities. These images are, perhaps, some of the first in American history wherein the camera proved its potential to be a violent and violating technology.

By the eve of the American Civil War in 1861, the prevalence of the daguerreotype had waned, overtaken by a new photographic technology: the wet-plate process. Unlike daguerreotypes, which produced a single, non-reproducible image on a metal plate (there was no negative), the wet-plate photograph allowed unlimited paper prints (the positive) to be made from a single exposure (the negative, the product of the wet-plate process). By allowing for multiple prints, this updated technique helped meet the nearly insatiable demand among all classes for photographs. The negative-to-positive process would be the default in photography for the next hundred and fifty years, until digital technology took over in the twenty-first century.



Charles Sheeler, Crisscrossed Conveyors, River Rouge Plant, Ford Motor Company, 1927, gelatin silver print.

PRECISIONISM: PICTURING MODERN ARCHITECTURE

Throughout the nineteenth century and into the twentieth, photography was transforming the arts and sciences by opening up new ways to view and record the world. But because of its mechanical foundations, photography was not considered an art form. On the

fringes of the fine arts, photographers turned their lenses to the rapidly industrializing landscapes of the world's cities, which were a kind of parallel medium: a new architecture in metal.

Although such photographic projects were primarily documentary in nature, made to celebrate technological advances like the building of bridges, factories, and elevated train lines, these projects were not without artistry. **Precisionism** was an arts movement focusing on the built environment that emerged in the United States. Borrowing from **Cubism** (a worldwide art movement that abandoned perspective to break the picture plane down into abstraction), Precisionism celebrated the new American landscape of skyscrapers, bridges, and factories. Applied to machinery, to industrial architecture, and to the tall buildings of urban skylines, Precisionism evacuated landscapes of human presence to emphasize the remote, impersonal appeal of machinery's pristine geometries.

Charles Sheeler's *Crisscrossed Conveyors, River Rogue Plant, Ford Motor Company* is one example. It shows a beautiful and balanced view of modern American industry. Depicting the complex interlocking industrial landscape of the Ford Motor plant in Michigan, Sheeler's ordered composition suggests an effort to find heroic order and balance in the operations of a factory. Commissioned by Ford to create a series of views of his factory, Sheeler's view is celebratory. The crossed diagonal conveyor belts are anchored by the verticals of the smokestacks, which call the viewer's gaze upward as if in religious contemplation of the new modernist divine. "It may be true," Sheeler wrote, "that our factories are our substitute for religious expression."³³

SELECTED WORK: *Penn Station, Interior*, Berenice Abbott, c. 1935-

38

Arriving in New York City in 1929 after building a successful photography career in Paris, the American photographer Berenice Abbott was riveted by the rapid transformation of the city. "Old New York is fast disappearing," Abbott observed, continuing:

At almost any point on Manhattan Island, the sweep of one's vision can take in the dramatic contrasts of the old and the new and the bold foreshadowing of the future. This dynamic quality should be caught and recorded immediately in a documentary interpretation of New York City. The city is in the making and unless this transition is crystalized now in permanent form, it will be forever lost...The camera alone can catch the swift surfaces of the cities today and speaks a language intelligible to all.³⁴

These convictions would shape Abbott's work as a professional photographer for the next decade and shape her best-known body of work: the documentation of rapidly urbanizing New York City. She worked on the project independently through the early years of the Great Depression, but in 1935 was able to secure funding

from the Federal Art Project (a part of the Works Progress Administration, organized by the United States Government). The photographs from this state-funded project were published collectively in 1939 as *Changing New York*, an illustrated book that was both a critical and commercial success. Today, it remains a classic text in photography.

Included in the project was *Penn Station, Interior*, which is dated to between 1935 and 1938. It shows an interior view of the soaring train hall at Pennsylvania Station, a primary transit hub in central Manhattan. In her Precisionist view of the gloriously modern structure, Abbott employs her signature worm's-eye-view perspective, tilting the angle of the camera upward to glorify in the soaring glass-and-iron ceiling. The feeling of pseudo-religious reverence present in Sheeler's Precisionist landscape is on display here, too. The long exposure time Abbott employed turned the filtered light hazy, casting the scene below in hushed reverence and heightening the tonal contrasts between lights and darks. Only the few human figures who remained stationary for the duration of the long exposure are present in the photograph, lending gravity to this image of what should be a bustling train hall filled with rushing passengers. Her photograph is an artful celebration of technology—both the photographic medium, with its potential for artful manipulations, and this new architecture of glass and metal.

Abbott's work is also an offering to one of the new cathedrals of the industrial city. Pennsylvania Station was an enormous undertaking and an impressive engineering feat. It took up eight acres of city space—two city blocks from 31st to 33rd streets and from 7th to 8th Avenues. The resulting railway station, completed in 1910, was a beautiful Beaux-Arts structure recalling classical traditions. Designed by McKim, Mead, and White, it was one of the most magnificent and one of the most architecturally significant buildings in New York City.

But it tragically has not survived. In 1963, the beautiful railway station was demolished due to falling commuter demand and to make way for what is today Madison Square Garden. As demolition began, public outrage swept national news syndicates. Though it was too late to save Penn Station, the controversy is today cited as a catalyst for the architectural preservation movement in the United States, particularly in New York City. Two years after Penn Station's demolition commenced, the city passed a landmarks preservation act and created the New York City Landmarks Preservation Commission.

What does remain of the beautiful structure are Abbott's photographs of it. These documents fulfill her ambition for the medium of photography by allowing us to know history through her visual archive. As Abbott herself said, "Photography...teaches you to see."³⁵ Looking back on Abbott's photographs of a changing New York, we are not only taught to see, but also *made* to see the celebratory spirit of industrial progress, modern design, and the artful possibilities of the photographic medium.



Photograph of Berenice Abbott, taken by Hank O'Neal, November 18, 1979.

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SECTION V SUMMARY

The Camera Obscura

- The camera obscura is an ancient optical device used by scientists and artists to copy views of the world in a direct manner.
- In its earliest iteration, a camera obscura was a darkened room in which a tiny opening in one wall acted like a lens, focusing an upside-down image of the scene outside onto the opposite wall.
- Over time, the camera obscura was made smaller and portable, becoming a key technology facilitating the invention of photography.

Early Experiments in Fixing an Image

- The timeline of photography's invention, when considered minutely, is surprising: all the basic materials needed to create a photograph were well-known from the Renaissance forward.
- It took decades of work from scientists and inventors across the globe to develop a method for producing a permanent image.
- One early inventor working independently in Brazil was French artist and cartographer Antoine Hércules Romuald Florence, who developed a technique for using the sun and light-sensitive paper to make copies of written documents. While Florence was able to fix his images by halting the light-sensitivity of the paper through a chemical process, his photographs lacked clarity and detail.
- In England, amateur scientists Thomas Wedgewood and Humphry Davy conducted similar experiments in light-writing, but they could not understand how best to fix the captured image.

Selected Work: *View from the Window at Le Gras*, Nicéphore Niépce, 1827

- Looking to capitalize on the huge cultural demand for image copying and capture, in the first decades of the nineteenth century the French amateur scientist Nicéphore Niépce started experimenting with new technologies.
- His first efforts involved exposing treated paper within a camera obscura, but the image was indistinct, and the tones of the image were reversed, so that darks were made light and

lights dark. (Today we know this reversal as the negative-positive process.)

- Next, Niépce successfully used sunlight to create a copy of an engraving on paper. The success of this process, which used a pewter plate coated with bitumen of Judea, led to what is today considered the world's oldest surviving permanent photograph.
- *View from the Window at Le Gras* is the result of a light-sensitive pewter plate being placed in the darkened chamber of a portable camera obscura and exposed to sunlight for eight hours. Then, it was rinsed with iodine fumes to fix the image, halting its sensitivity to light. The image is reversed laterally and is a direct positive of the view from an upper story window at Niépce's French estate. Hazy and mysterious, the image is a captivating piece of photographic history.

The Daguerreotype

- Following his successes, Niépce teamed up with Frenchman Louis Daguerre, who further built upon the older inventor's chemical knowledge to develop the world's first commercially successful photographic process: the daguerreotype.
- This new process used a polished silver-plated copper sheet, made sensitive to light by exposure to iodine fumes, and produced an incredibly sharp and detailed image and cut an hours-long exposure down to several minutes. After exposure, the plate was treated with mercury fumes to bring out the latent image and was then washed with sodium chloride to fix the image.
- Daguerre had little clue as to how transformational his new process would become, but he did understand that it would be difficult, if not impossible, to patent. To capitalize on his invention, he sold instructions for recreating the "daguerreotype" to the French government, who published them and thus "gifted" the new technology of photography to the world.

Selected Work: *Frederick Douglass*, c. 1855

- The daguerreotype met with almost immediate success, especially in the U.S., where photography studios popped up in every major

city to offer quick and affordable portraits to sitters who before could not afford or gain access to painted portraits of loved ones.

- Culturally, Victorian-era society responded to the daguerreotype's perceived ability to capture a sitter's "character," which eased the larger social anxieties of a rapidly changing class-based society.
- One man who understood the rhetorical power of photography was the American abolitionist, Frederick Douglass. Always presenting himself as a serious intellectual and gentleman, he had himself photographed more than 160 times throughout his life, becoming the most photographed person of the nineteenth century.
- For Douglass, the key strength of the daguerreotype was its objectivity. He felt that he would never receive "an impartial portrait" from a white painter. But a camera would record reality precisely as it appeared. Photography was a technology that thus allowed Douglass to overcome racist caricatures then prevalent in the visual arts to instead show him as he was.

Photographic Portraiture: Democratization and Control

- For Douglass and others like him, the objectivity promised by the photograph combined with its affordable price point made it a powerful equalizing force in larger society.
- While photography did democratize the genre of portraiture, allowing most people to keep images of themselves and their loved ones, it was not necessarily the great equalizer that Douglass had hoped for and was used to document and thus control criminals, immigrants, and the enslaved.
- The daguerreotype was also used as an intellectual bludgeon to support the pseudoscientific field of polygenesis, which claimed African peoples with darker skin tones were inferior to those with lighter skin. The images that remain from the Zealy-Agassiz zoological study stand today as some of the most haunting and painful images to be made in the era of the daguerreotype.
- By the 1860s, the prevalence of the daguerreotype had waned, overtaken by the

wet-plate process, which could reproduce unlimited positives from a single negative. The negative-to-positive process would be the default in photography for the next hundred and fifty years, until digital technology took over in the twenty-first century.

Precisionism: Picturing Modern Architecture

- One of the first art movements to come out of the United States was called Precisionism. The style borrowed from Cubism to celebrate the new American landscape of skyscrapers, bridges, and factories by highlighting their pristine geometries in symmetrical, aestheticized paintings and photographs.
- Charles Sheeler's *Crisscrossed Conveyors, River Rogue Plant, Ford Motor Company* is one example. Works such as this reflected the new American veneration of factories, industry, and modern architectural design.

Selected Work: *Penn Station, Interior*, Berenice Abbott, 1935–38

- The American photographer Berenice Abbott, famous for her documentation of a rapidly industrializing New York City, captured the city's buildings and bridges in a Precisionist fashion. In a large project for which she received support from the Federal Art Project (part of the WPA), Abbott grew into her role as a daring and talented photographer of the urban landscape.
- *Penn Station, Interior*, is a reverentially quiet view into the soaring train hall at Pennsylvania Station. By using a long exposure time, Abbott muted and softened the light that filters through the soaring ceiling. The heightened tonal contrasts between lights and shadows further dramatize this pseudo-religious scene, a mesmeric celebration of the new cathedrals to American modernism that represented train travel's conquest of time and space.
- Because the train station has not survived, Abbott's archival photographs of the structure have become even more significant. An example of how photography can blend the artful with the documentary, *Penn Station, Interior* is a beautiful celebration of modernizing New York.

SECTION VI

The Machine as Art and Artist

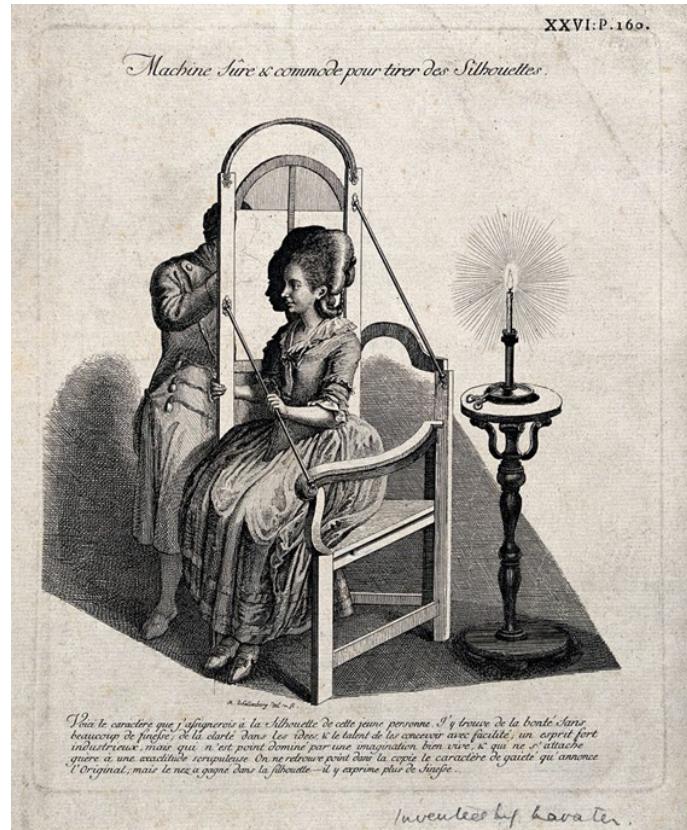
As we have seen, throughout history advances in technology have transformed the visual arts. It should come as no surprise, then, that as industry mechanized more elements of everyday life, the arts underwent a mechanical revolution as well. From the development of a technology that automated the process for creating portraits in silhouette, to photography's metamorphosis into film and television, to making the automobile into an artistic medium in its own right, mechanized technologies changed the scope and focus of the visual arts throughout the nineteenth and twentieth centuries. Artists responded to these changes by transforming mass-made machines like televisions and cars into critical and thought-provoking works of art.

THE PHYSIognotrace

Before photography's invention and global introduction in 1839, the most prominent mode of portrait-taking was the silhouette. Produced by first tracing the sitter's cast shadow and subsequently cutting out or painting in the outlined form, a silhouette's black and featureless shape exists today as the record of the sitter's once-present body. Unlike oil portraits, which could take hours or days to complete, "shadow portraits," as they were called in the nineteenth century, were inexpensive likenesses that could be obtained in a matter of minutes.

A **physiognotrace** is a mechanized contraption that copied a sitter's traced profile onto a twice-folded piece of white paper to produce multiple identical silhouettes in miniature. Hence the term conveys both its action (to trace) and the subject it reproduced (physiognomy, i.e., a person's facial features or expression). Invented in France by the engraver Gilles-Louis Chrétien in about 1786, the physiognotrace was part entertainment and part artistic venture. The machines were widely popular across Europe and America in the decades leading up to the introduction of the daguerreotype.

In response to the popularity of silhouettes, by



Johann Kaspar Lavater, Silhouette Machine, c. 1780.
Engraving from Lavater's Essays on Physiognomy.

1802 the American artist Charles Willson Peale had incorporated a physiognotrace machine into the offerings of his new museum in Philadelphia. Peale's museum was founded in 1784 as an enlightened house of learning and the first natural history museum in America. Full of natural history specimens, science models, taxidermized birds, wax figures, and portraits of American leaders, Peale's museum attempted to attract as wide an audience as possible. In this gallery space, the physiognotrace was derived from the designs of British inventor John Hawkins.

A person would climb into the wooden-frame structure, sit, and turn to the side to pose. The operator of the

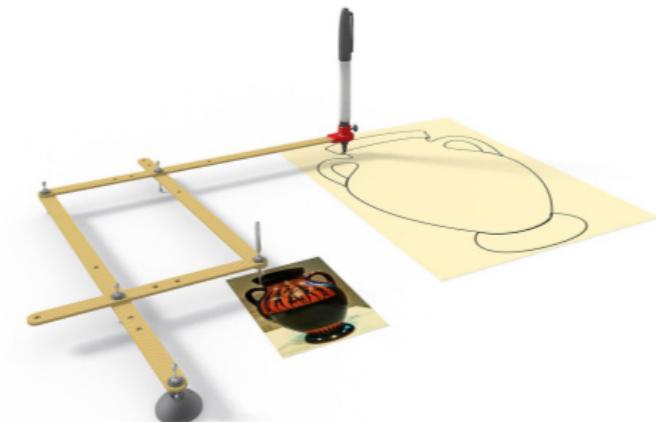


A replica of J. I. Hawkins' physiognotrace machine. The physiognotrace featured a brass bar connected to a pantograph that was traced along the actual boundaries of the face.

University Art Gallery, University of Pittsburgh

machine then used the attached **pantograph** to trace the outline of the sitter's silhouette, the shadow of which was cast upon a screen set between the silhouettist and the subject. While the operator traced the sitter's head, the mechanism impressed the image onto a piece of paper that was folded to produce multiple portraits. The operator then cut away the center of the paper, leaving a "hollow cut" image. When laid over a backing of black paper, the cut white outline materialized into a head in profile. Hence the physiognotrace was used as a kind of advanced reproductive tool by the artist. It facilitated the creation of a semi-automated portrait and keepsake that directly recorded the face of the sitter. These hollow-cut silhouettes could then be framed, compiled into an album, or kept loose as a souvenir of the Peale museum.

Many scholars have rightly grouped Peale's project and



Model pantograph in action. The smaller image at left is manually traced by the machine's operator; its motions are replicated simultaneously in the image at right to make a copied image of the vase in outline.

the physiognotrace more broadly with the period belief in physiognomy and **phrenology**—pseudo-sciences privileging the face as a coded vehicle revealing the character that lay within. Phrenology understood an individual's innate character to be legible in facial features and the contours of the cranium. Criminals, for example, were believed to have low, sloping foreheads, hard shifty eyes, and hawk-like noses. In a period anxiously preoccupied by an individual's "character," moral or otherwise, physiognomy and phrenology appealed to a middle class seeking new ways, beyond pedigree, to understand temperament and personal achievement. The silhouette medium was an ideal vehicle for augmenting these anxieties and interests.

Like the photographs that would eventually supersede them, silhouettes were seen as an unimpeachably direct and accurate form of representation. As the art historian Wendy Bellion has shown, this label of "true representation" gave silhouettes an honored position in the United States during the early republic period when American society was consumed by broad-ranging debates about representation in politics. Hence the silhouette's plain style came to represent the new nation. Its form resonated with the values of a republican society that "espoused modesty and distained ornament."³⁶ In this way, the physiognotrace and silhouettes made from it helped to shift standards for portraiture: no longer was an idealized representation accepted without question, as it had been with painted portraits. Instead, clients favored truthful, accurate, and real images of themselves

and their loved ones. In many ways this change, led by the popularity of the silhouette medium, laid the

groundwork for the success of photography a few decades later.

SELECTED WORK: Moses Williams, Raphaelle Peale and Moses Williams, c. 1803

Extant letters and municipal records prove that from 1802 until 1823, a mixed-race man named Moses Williams regularly operated the physiognotrace in the Long Room of Peale's Museum in Philadelphia.³⁷ Artist and museum owner Charles Willson Peale enslaved Williams. In a hollow-cut silhouette today in the collection of the Library Company of Philadelphia, two-dimensional sheets record the bust of a young man—the traced physical index of his body. A lock of his hair waves down in front of his forehead, pointing to the delicate outline of eyelashes, nose, and lips. Crisp linen ties at the base of his hair and the cravat at his neck unfurl jauntily, giving further dimension and visual interest to this hollow-cut silhouette.

The man's identity, profession, and skill distinguish this particular silhouette further still. At the museum, Williams quickly learned to cut out the machine's drawn profiles with such dexterity and accuracy that, as Rembrandt Peale (a prolific painter and one of Charles Willson Peale's sons) would later remark, "the machine was confided to his custody with the privilege of retaining the fee for drawing and cutting."³⁸ Williams earned enough from these eight-cent commission fees to secure his freedom from bondage. In the machine's initial year, he fabricated the images of as many as eight thousand citizens of the early republic.³⁹ His success in the profession was so profound that he amassed "a fund sufficient to buy a two story brick house" and marry the Peale family's white cook.⁴⁰

As this remarkable black man cut out white paper outlines and backed them in black paper, he challenged dichotomous racial strictures of his day, earning his freedom and declaring his identity as a man with the power to create historical records. The incredible story of Moses Williams helps to excavate some trace of these people of color who were otherwise excluded from the archive, allowing us to re-read the blackness of the silhouette as a proud declaration of the sitter's skin color.

Rapidly gaining popularity in the first decades of the nineteenth century, the medium of the silhouette radiated out from Williams's physiognotrace and the museum in Philadelphia's Independence Hall. Silhouettes were easily, cheaply, and quickly delineated, and so became the chosen form of portraiture for a new class of everyday people—Americans. The silhouette's plain style came to represent the new nation; its form resonated with the values of a republican society that espoused modesty and rejected ornament.

So too was the silhouette the first widely articulated form of portraiture that was acutely democratic: all silhouettes were made from the same ready-made paper materials, all were purposefully mimetic objects, and none made distinctions between sitters in terms of social class. As a mode of representing reality, the silhouette referred back to a specific individual—a citizen—while formulating each into a part of the burgeoning body politic of the early United States. The detailed shape and formless interior of the silhouette's body thus becomes metaphoric for the merging of individual with nation, connoting the absolute presence of a person and their simultaneous abstraction into the multitude.

EADWEARD MUYBRIDGE AND INSTANTANEOUS PHOTOGRAPHY

The nineteenth century was an era of momentous transformation, driven in large part by advances in technology. Industrialization proceeded at breakneck speed. From the telegraph to the cotton gin, the

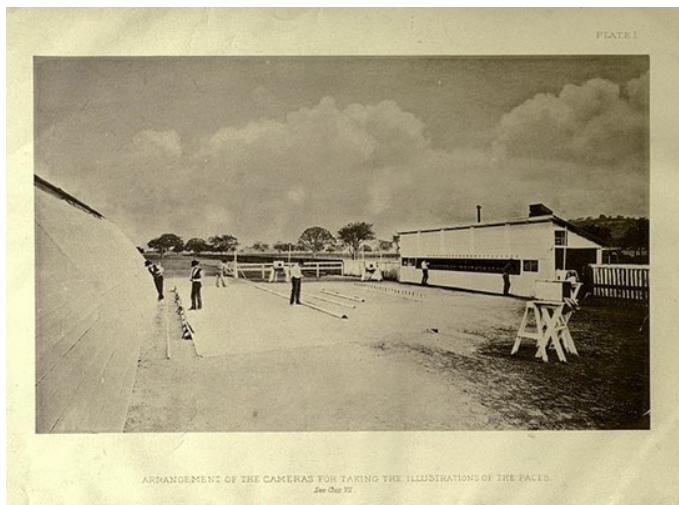
railroad to the steamboat, technologies changed daily human experience in radical ways. Through it all, the visual arts attempted to bind society's many disparate parts together.

As we saw in the last section, no technology had more impact on the field of the visual arts in the nineteenth



Charles Bentley, *Full Cry*, from *Fox Hunting*, 1828, color aquatint on paper. Before Muybridge's experiments in instantaneous photography recorded the moment-by-moment motion of a horse at full gallop, artists did their best to estimate the appearance of a galloping horse in fine art.

century than the invention of photography. Capturing the world precisely as it appeared, photography helped redirect artistic investigations of the world toward the expressive and the conceptual. No longer was the painter's first responsibility to represent the world as it was, for posterity. Now, artists were free to use color and form in more abstract ways. Impressionism, for example, emerged in 1872, the same year that the British-American photographer Eadweard Muybridge



Eadweard Muybridge's equipment for motion photography at Palo Alto in 1878. The twelve cameras utilized in Muybridge's famous racehorse experiment were placed approximately one foot apart. The resulting photographs were published in 1881 to great acclaim.

was commissioned to conduct a series of photographic experiments on animal locomotion in California. In order to study the movement of a galloping horse—a movement too fast for the human eye to register in detail—Muybridge deployed technological advancements in rapid shutter speed. In doing so, he developed a new kind of image-making: instantaneous photography.

SELECTED WORK: *The Horse In Motion, "Sallie Gardner,"* Eadweard Muybridge, c. 1878

In the 1870s, scientists hotly debated what was then a huge question: was there any moment in a horse's gait when all four of its hooves left the ground at the same time? Was there, in other words, any moment when a horse was suspended in midair? This issue was taken up by none other than Leland Stanford: railroad magnate, industrialist, founder of California's renowned Stanford University, and racehorse owner. Commissioning the British-American landscape photographer Eadweard Muybridge to work with him on the project, Stanford wagered that a horse did indeed have all four legs off the ground for a brief moment in time, one that passed too quickly for the naked eye to see. The resulting work transformed Muybridge's career and became the launching point for the first scientific study of motion using the technology of photography.

At Stanford's personal racetrack in Palo Alto, California, Muybridge devised a method for photographing a horse in motion using a series of twelve cameras spaced at twenty-one-inch intervals and attached to wires that were tripped as the horse galloped down the racetrack. For the experiments, Muybridge designed his own high-speed electronic shutter and electro-timer. Coupled with electrically powered shutter speeds of up to 1/1000th of a second, Muybridge's stop-action photographs revealed a new reality that broke time and motion into discrete, measurable, and visible units.

Publishing his findings in a now-iconic compendium of twelve images arranged in a grid, these separate views of instantaneous motion illustrate the consecutive phases of the horse's movement. The animal was captured at split-second intervals, held miraculously aloft in black silhouette against a numbered white background. Unlike the optical and coloristic effects explored by Impressionists during this same period, Muybridge's stop-action photography employed the objectivity of the camera, rather than the subjectivity of the human eye, in a scientific study of motion.

Following his success with Stanford in California, Muybridge worked at the University of Pennsylvania with the painter Thomas Eakins. There he produced more than 20,000 studies of men jumping, boxing, wrestling, fencing, and batting, and of women dancing and making beds, as well as numerous animal species, from birds to lions, trotting, galloping, and flying. Conducted between 1884 and 1887, the studies together produced a kind of encyclopedia of animal motion. Called *Animal Locomotion: An Electro-Photographic Investigation of Consecutive Phases of Animal Movements* and released in 1887, the volume was Muybridge's most important photographic study, proving widely significant for scientists across the fields of biology, botany, and physics.

The wide popularity of Muybridge's motion studies reveals a period fascination that surpasses the mere novelty of viewing stilled and dissected motion. The theorist and scholar Rebecca Solnit has explained this fixation by drawing connections between changing perceptions of time and movement in nineteenth-century culture. Indeed, until Muybridge's era, photography's long exposure times had not been able to capture movement, showing objects in motion only as a blur. By making motion visible, Muybridge's instantaneous photography came to represent the fast-moving time and the shifting cultural landscape of modern life.⁴¹

MUYBRIDGE'S ZOOPRAXISCOPE: A PRECURSOR TO FILM

Although Muybridge's astonishing photographs settled the question about a horse's gait by recording Sallie Gardner's moment of seemingly weightless suspension, some scientists and members of the public remained skeptical. They struggled to believe the evidence as presented by the camera. Muybridge's images looked so strange they appeared nearly fake, they said. But Muybridge did not let such attitudes dissuade him. To counter outspoken critics, he traveled throughout the United States and Europe to deliver lectures on animal locomotion.

To enhance his lectures and make them more persuasive, Muybridge illustrated them with a special machine he developed: a **zoopraxiscope**. Essentially, Muybridge's zoopraxiscope was a lantern that projected images in rapid succession onto a screen from photographs printed on a rotating glass disc. When projected via light at a high speed, the images created the illusion of a continuously moving picture.

An important precursor to modern cinema, Muybridge's zoopraxiscope made waves at Chicago's



The zoopraxiscope, a device Muybridge developed to project moving images in 1879.

1893 World's Columbian Exposition. Two years later, the commercial screening of the Lumière brothers' short films in Paris—following closely on the heels of Max Skladanowsky's rudimentary film footage shown in Berlin—marked the advent of film as an artistic medium. Running a closely timed sequence of still photographs through a projector at approximately twenty-four frames per second, the Lumière brothers

created the illusion of motion in real time. Through a neurological principle known as the “persistence of vision,” the human brain fills the gap between the still-frame images, resulting in an illusion of seamless continuity of motion. Film had officially been invented.

In the early twentieth century, cinema was quickly adopted by **avant-garde** artists as the perfect medium for seizing the spirit of modern life. (The term “avant-garde,” adopted from the French military term for “advance guard,” refers to modern, forward-looking artists who break with convention to create innovative modes of expression that are unorthodox, experimental, and radical.) Artist-made films of the 1910s and 1920s demonstrate an extraordinary range of effects. In Salvador Dalí and Luis Buñuel’s 1928 *Un Chien Andalou*, film is the Surrealist medium *par excellence*: a waking dream. By the 1970s, video emerged as a foundational medium for fine art, either as a documentary vehicle for performance art or in more visually lyrical artworks, wherein the film was itself the work of art.

TELEVISION

As film technology based on glass plate and then celluloid negatives developed and proliferated, it soon came to accomplish many disparate aims: communication, entertainment, reporting, recording, and artmaking, to name only a few. Film (and later video) was commercialized in advertisements and deployed as propaganda by political figures. It allowed people to watch as distant events—from wars to baseball games—happened in real time. Transforming how information was transmitted and shared, film would progressively integrate itself into all fields of human life over the course of the twentieth century. Most prominent among these changes was the rapid growth of one machine in particular: television.

Few inventions have had as much effect on modern American society as TV. America’s first commercially produced television sets were based on the mechanical television system, which was made according to the designs of Scottish inventor and engineer John Baird. These sets were exhibited for the first time to the public in 1928. Soon after, the world’s first television stations began broadcasting in the U.S.⁴²

By 1946, six thousand homes in the U.S. had television sets. Just five years later in 1951, that number had exploded to twelve million homes. Fast-forward to the



A family watches TV in 1958. Few inventions have had as much effect on modern American society as TV.

late 1990s, and 98 percent of U.S. homes had at least one television set, used for an average of more than seven hours a day.⁴³ While many factors contributed to the extraordinary and explosive growth in TV use and availability during the 1950s and 1960s, World War II was one of the most important. While the development of television technology stopped during the war, research on communications systems, notably radar, translated directly to improved TV design and usability after the war’s end.

Television design was one of many thousands of changes brought on by World War II. Scholars also view the Second World War as a turning point in the history of art. As a whole, the nucleus of artmaking shifted after 1945—from Paris to New York—and America’s first major art movement captured the art world’s focus. **Abstract Expressionism** flourished in New York during the 1950s and 1960s and came to dominate art production on an international level. Abstract Expressionism is a type of abstract art characterized by gestural brushstrokes and the impression of spontaneity.

The postwar period also witnessed a radical shift in the kinds of materials artists deemed viable for artmaking. Machine-made materials, for example, became a key aspect in many artists’ practices, and artists no longer felt the need to treat the machine as a mere theme or source of inspiration. After 1945, artists made the machine itself into art.

SELECTED WORK: Magnet TV, Nam June Paik, 1965

The Korean-born American artist Nam June Paik (백남준), commonly hailed as the “father of video art,” was at the vanguard of a movement utilizing television as a legitimate artistic medium. Paik treated the television screen almost as if it were a canvas, shaping it with precision, color, and lyricism. He refashioned perceptions of this electronic medium with thought-provoking manipulated TV sets, live performances, global television broadcasts, single channel videos, and video installations. During a period when the electronic moving image and media technologies were increasingly present in daily life, Paik established an unprecedented conceptual relationship between technology and human life. As the scholar John G. Hanhardt has argued, “As avant-garde filmmakers had achieved with cinema, Paik sought to make television strange and unfamiliar...dislodg[ing] our comfortable and uncritical view.”⁴⁴

Paik’s *Magnet TV* from 1965 is among his earliest television-based artworks. It is comprised of a black-and-white Conrac CRT television set inside a Magnavox cabinet, which was modified by the artist. Most importantly, Paik rewired the TV so that it would not receive broadcast signals and set a large horseshoe magnet on top. When placed against the surface of the cathode-ray tube of the television, the industrial-grade magnet bends and distorts the TV’s electronic signal to create abstract geometric patterns on the screen. By destroying the machine’s intended function—to broadcast external newscasts—Paik transformed the television into an electronic sculpture.

When the piece was first exhibited in 1965, it was intentionally interactive. Viewers were encouraged to move the magnet along the top of the cabinet, which meant they themselves could alter the abstract imagery on the monitor screen. (In 1982, this interactive element was halted due to safety concerns.) By allowing the viewer’s actions to have an instantaneous effect on the work itself, Paik’s *Magnet TV* brought interactive aspects of 1960s **performance art** into the medium of sculpture.

In addition to referencing the foundational forms of performance art, *Magnet TV* also connected to the principles of painting’s then-dominant aesthetic: Abstract Expressionism. At the same time that Jackson Pollock was making his famous drip paintings by spreading canvas on the floor and dribbling paint across it, Paik was also removing the “hand” of the artist in his abstractions. The flickering, backlit patterns emerging on screen are generated by the force of the magnet bending and distorting the TV’s electronic signal—a unique aesthetic that no oil painting could emulate, and one that was produced solely by the science of the machine. More specifically, the magnet’s power hinders the cathode rays from filling the screen’s rectangular surface. This pushes the field of horizontal lines upward, creating strangely graceful loops and whorls within the magnet’s gravitational field.⁴⁵ These patterns have endless variations when the magnet is moved across the top of the television.

In 1971, Paik explained his reasoning for employing the television in his artworks. “The nature of environment is much more on TV than on film or painting,” he said, continuing, “In fact, TV (its random



Nam June Paik in New York City, 1983.

movement of tiny electrons) is the environment of today.”⁴⁶ This was quite a claim, but Paik’s hyperbole was based in reality. In the 1960s, network television was the ultimate populist medium. Shows like *Bonanza* and *The Beverly Hillbillies* dominated the airwaves, which were controlled by a small monopoly of broadcasters. During this period of societal and cultural change, Paik combined the expressive capacity and conceptual power of performance art with the new technological possibilities associated with the moving image. In this way, his radical *Magnet TV* also reflects his relationship to the politics and anti-art movements of the 1950s, 1960s, and 1970s. These movements had an outsized impact on modern art practices and continue to shape the art world today.

Beginning with Paik and others like him, the field of art turned further toward the realm of anthropology by interrogating the social conditions of contemporary human society. With his television-based works, Paik upended traditional categories of art. He turned these machines into something that is neither painting nor pure sculpture, but instead belongs to a separate sphere—a world apart, capable of criticizing social norms. Made during the period of the Cold War, when the equilibrium between human beings and machines was a source of anxiety for many Americans, Paik drew attention to the mutability and manipulability of the television through his interactive artworks, asking viewers to think deeply about the technology they spent so much time consuming.

THE AUTOMOBILE

As the invention of television transformed communication and information delivery systems in the twentieth century, the automobile vastly altered the movement of people and goods and reshaped the growth patterns and development of cities. By the time the car had become the primary mode of personal transport in the United States during the 1910s and 1920s, the industry was already propelling the development of a newly structured society based on consumerism and transforming the American landscape with the building of many thousands of new paved roads.

By the 1920s, the automobile was well on its way to revolutionizing the ancillary industries of steel, petroleum, and rubber. It also spurred the growth of tourism and related economies like service stations, roadside restaurants, and motels. In 1956, the largest public works program in U.S. history was signed into being by President Dwight Eisenhower: the Interstate Highway Act. The bill created a 41,000-mile system of national highways that would improve road safety, increase travel efficiency, and decrease traffic jams. This inaugurated a vast system of interstate highways that connected major cities in a single nonstop network.

Ushering in a new era dominated by “car culture,” the automobile directly impacted the rapid development of vast swaths of suburbs around American cities, led to the demise of downtown districts, and revolutionized



In 1956, the largest public works program in U.S. history was signed into being by President Dwight Eisenhower: the Interstate Highway Act.

the architecture of the typical American home. By 1980, 87.2 percent of households in the U.S. owned at least one motor vehicle, and 51.5 percent owned more than one.⁴⁷ Americans were officially auto-dependent. Few other technological forces have so revolutionized the way we work, live, and play.

It should come as no surprise, then, that just like the television’s screen, a modernist artist working in materials alternative to oil on canvas took up the form

of the automobile to create titanic works of sculpture. These hulking boulders of twisted metal engage with

America's complicated love affair with the car by critiquing it and celebrating it in equal measure.

SELECTED WORK: *Velvet White*, John Chamberlain, 1962

John Chamberlain was one of the most influential Abstract Expressionists working in three dimensions during the twentieth century. His primary medium was a far cry from the oil and canvas prioritized by his friends Franz Kline and Willem de Kooning, two prominent Abstract Expressionist painters whose work paralleled his own. Instead, Chamberlain's sculptures were crafted from the mangled fenders, doors, bumpers, and hoods of scrapped and abandoned cars.

Chamberlain began working with these materials in the context of late-1950s assemblage or Junk Art, in which scrap metal was reclaimed and reinterpreted as fine art. According to the artist's biography proffered by his estate, it was during the summer of 1957 that Chamberlain first began using the automobile as an integral part of his art:

[He] first encountered a 1929 Ford Pie Wagon in the backyard of his friend Larry River's house in Southampton, New York. He was inspired to pull off the fenders and drive over them with his car, then twist and weld the metal together with steel rods, thereby creating the famous piece Shortstop. This moment marked the beginning of the artist's long engagement with making sculpture from recycled automobile parts—works that defied traditional definitions of what sculpture should be.⁴⁸

Completed five years after *Shortstop*, in *Velvet White* viewers can see the exhaust pipes, gaskets, and doors original to the car Chamberlain salvaged for this life-size sculpture. Crushed and compressed until they are only just recognizable, these materials record the violence of their creation. Many scholars have remarked upon this facet of Chamberlain's work as evocative and even critical of America's thousands of fatal car crashes.

As such, the crushed and hollowed metal of *Velvet White* becomes a resonant symbol of the automotive industry, which dominated America's economic formation in the post-World War II period. Chamberlain's use of salvaged cars alludes to the cycle of production and disposal that fueled the consumer culture of the 1950s and 1960s, which was developing rapidly. Emerging from this watershed moment—the birth of car culture—Chamberlain's works reveal the central position of the automobile in American culture. And while the bashed and warped forms of *Velvet White* suggest a certain kind of fatal violence, the sculpture's coolly monochrome elegance, delicate lightness, and velvet-soft exterior is equally celebratory of the American car.

Indeed, as Chamberlain worked during the early 1960s, cars represented the nationalistic ideals of freedom, wealth, and cutting-edge technology. Scholars and critics have thus concluded that the meaning of Chamberlain's sculptures should be interpreted as ambiguous: a critique of consumerist culture and the horrors of American car culture, and, at the same time, a celebration of that same culture's utopic freedom and unbridled spirit of adventure.

The art historian Susan Davidson has called Chamberlain "an inveterate rebel." Not only did he parody the



John Chamberlain in May 2011 at his studio in Shelter Island, N.Y.

Credit: Librado Romero/The New York Times

snobbery of the art world by transforming junk into blue chip sculptures sold for high prices in fancy galleries. He also “violated the formalist prohibition against the use of color in sculpture.”⁴⁹ In fact, his 1962 *Velvet White* is an anomaly in his practice. Much more standard are the whirling colors found in wall-mounted sculptures like *Dolores James*. Turquoise, emerald green, cherry red, and lemon yellow lend the piece depth and vibrancy. Made in the same year as *Velvet White*, Chamberlain’s *Dolores James* echoes the explosive energy found in the powerful brushstrokes of Abstract Expressionist painters like Willem de Kooning.

As such, *Velvet White* is an anomaly in Chamberlain’s otherwise coloristically vibrant practice. Referencing the plain white of a blank canvas—a medium the artist imagined himself in conversation with—Chamberlain simplifies his sculptural medium, distilling it into its most salient parts. Like the groundbreaking modernist painter Robert Rauschenberg’s *White Painting* of 1951, which was made exclusively with white paint, the blank color of *Velvet White* allows the world outside the sculpture to be reflected within it.

Painted entirely white, Rauschenberg’s canvases were purely conceptual art pieces, intended to allow the painted canvas to reflect changes in light and the chance effects of shadows in the surrounding space, rather than representing a more traditional scene. In a 1999 interview, Rauschenberg said of his *White Paintings* series: “I called them clocks. If one were sensitive enough that you could read it, you would know how many people were in the room, what time it was, and what the weather was like outside.”⁵⁰ Chamberlain’s sculpture functions in a similar fashion: minimalistic and refined, it showcases the past and present of America’s dependence on the automobile.

SECTION VI SUMMARY

The Physiognotrace

- During the eighteenth and early nineteenth centuries, silhouettes were the most prominent mode of portrait-taking across Europe and the Americas because they could be executed rapidly and cheaply.
- The physiognotrace was a mechanized contraption that copied a sitter’s traced profile to create a silhouette.
- The operator of a physiognotrace used an attached pantograph to trace the outline of the sitter’s silhouette—the shadow of which was cast upon a screen set between the silhouettist and the subject—onto a piece of paper. The operator then cut away the center of the paper, leaving a “hollow cut” image that was laid over a backing of black paper.
- Like the photographs that would eventually supersede them, silhouettes were seen as an unimpeachably direct and accurate form of representation. In this way, the physiognotrace and silhouettes made from it helped to shift standards for portraiture: no longer was an idealized representation accepted without question, as it had been with painted portraits. Instead, clients favored

truthful, accurate, and real images of themselves and their loved ones.

Selected Work: Moses Williams, Raphaelle Peale and Moses Williams, c. 1803

- Moses Williams was a mixed-race black man enslaved by the American artist and museum owner Charles Willson Peale. Between 1802 and 1823, he regularly operated the physiognotrace in the Long Room of Peale’s Museum in Philadelphia.
- Williams quickly learned to cut out the machine’s drawn profiles with such dexterity and accuracy that he earned enough from these eight-cent commission fees to secure his freedom from bondage.
- His self-portrait in hollow-cut silhouette challenged racial strictures of his day, declaring his identity as a man with the power to create historical records.
- The silhouette was the first widely articulated form of portraiture that was acutely democratic: all silhouettes were made from the same ready-made paper materials, all were purposefully mimetic objects, and none made distinctions between sitters in terms of social class. As such the silhouette’s plain style came to represent the new nation; its form resonated with the values of a republican society that espoused modesty and rejected ornament.

Eadweard Muybridge and Instantaneous Photography

- In 1872, the British-American photographer Eadweard Muybridge was commissioned to conduct a series of photographic experiments on animal locomotion in California.
- In order to study the movement of a galloping horse—a movement too fast for the human eye to register in detail—Muybridge deployed technological advancements in rapid shutter speed. In doing so, he developed a new kind of image-making: instantaneous photography.

Selected Work: Eadweard Muybridge, *The Horse in Motion, "Sallie Gardner," c. 1878*

- Railroad magnate, industrialist, and founder of California's renowned Stanford University, Leland Stanford commissioned Eadweard Muybridge to help him study the movement of a galloping horse at his horse farm in central California.
- Muybridge devised a method for photographing a horse in motion using a series of twelve cameras spaced at twenty-one-inch intervals and attached to wires that were tripped as the horse galloped down the racecourse, designing his own high-speed electronic shutter and electro-timer to accomplish the task.
- The resulting compendium of twelve images was arranged in a grid to illustrate the consecutive phases of the horse's movement. Muybridge's stop-action photography employed the objectivity of the camera rather than the subjectivity of the human eye in one of the world's first scientific studies of motion.
- By making motion visible, Muybridge's instantaneous photography came to represent the fast-moving time and shifting cultural landscape of modern life.

Muybridge's Zoopraxiscope: A Precursor to Film

- Following his success in California, Muybridge traveled throughout the United States and Europe to deliver lectures on animal locomotion.
- To enhance his lectures and make them more persuasive, he illustrated them with a special machine he developed, called a zoopraxiscope. This lantern projected images from a rotating glass disc onto a screen. When projected via light at a high speed, the images created the illusion of a

continuously moving picture.

- The zoopraxiscope quickly became an important precursor to modern film cinema, which premiered in Europe in 1895 and was adopted by avant-garde artists in the first decades of the twentieth century as the perfect medium for seizing the spirit of modern life.

Television

- Transforming how information was transmitted and shared, film progressively integrated itself into all fields of human life over the course of the twentieth century. Most prominent among these changes was the rapid growth of one machine in particular: television.
- Few inventions have had as much effect on modern American society as TV. By 1951, twelve million homes in the U.S. had television sets. Part of the rapid increase in the availability and use of television sets was the incorporation of war-time technological developments.
- Scholars also view the Second World War as a turning point in the history of art. As a whole, the nucleus of artmaking shifted after 1945—from Paris to New York—and Abstract Expressionism, America's first major international art movement, became the dominant style of artmaking.

Selected Work: Nam June Paik, *Magnet TV, 1965*

- The Korean-born American artist Nam June Paik, commonly hailed as the “father of video art,” was at the vanguard of a movement utilizing television as a legitimate artistic medium. Paik treated the television screen almost as if it were a canvas, shaping it with precision, color, and lyricism.
- During a period when the electronic moving image and media technologies were increasingly present in daily life, Paik established an unprecedented conceptual relationship between technology and human life.
- Paik’s *Magnet TV* from 1965 is among his earliest television-based artworks. Paik rewired an existing black-and-white television so that it would not receive broadcast signals and set a large horseshoe magnet on top, which bent and distorted the TV’s electronic signal to create abstract geometric patterns on the screen. By destroying the machine’s intended function—to broadcast external newscasts—Paik transformed the object of the

television into an electronic sculpture.

- The work actively referenced the interactive elements of performance art and the aesthetic principles of Abstract Expressionism.
- Beginning with Paik and others like him, the field of art turned further toward the realm of anthropology by interrogating the social conditions of contemporary human society. Paik turned machines into something that is neither painting nor pure sculpture, but instead belongs to a separate sphere—a world apart, capable of critically interrogating social norms.

The Automobile

- Automobiles vastly altered the movement of people and goods and reshaped the growth patterns and development of cities. The industry helped to develop a newly structured society based on consumerism that transformed the American landscape.
- The Interstate Highway Act of 1956 created a 41,000-mile system of national highways that connected major cities in a single nonstop network and ushered in a new era dominated by “car culture.”

Selected Work: John Chamberlain, *Velvet White*, 1962

- Artist John Chamberlain’s hulking boulders of

twisted metal engage with America’s complicated love affair with the car by critiquing it and celebrating it in equal measure.

- One of the most influential Abstract Expressionists working in three dimensions during the twentieth century, Chamberlain made titanic sculptures from the mangled fenders, doors, bumpers, and hoods of scrapped and abandoned cars.
- In *Velvet White*, crushed and compressed cars are only just recognizable, recording the violence of their creation and suggesting a critique of America’s thousands of fatal car crashes.
- At the same time, Chamberlain’s use of salvaged cars alludes to the cycle of production and disposal that fueled the consumer culture of the 1950s and 1960s, which was developing rapidly. Thus, Chamberlain’s works can be seen as a celebration of car culture’s utopic freedom and unbridled spirit of adventure.
- The unique palette of this particular Chamberlain sculpture references the plain white of a blank canvas—a medium the artist imagined himself in conversation with—as well as Robert Rauschenberg’s *White Paintings* of the early 1950s, which, in their radical minimalism, are fundamentally conceptual art pieces made to reflect the atmospheric conditions of their environment.

Conclusion

Over the course of the twentieth century, machines were progressively integrated into all fields of human activity, including artistic creation. Painters used machine-made paint born of synthetic plastics and other lab-grown materials. Conceptual artists employed factory “ready-made” objects as indicators of consumerism and the industrial sphere. Portraitists turned to photography as a primary medium, and performance artists used video to record artworks that would never happen again, thereby shifting the “stuff” of the work from the physical experience to the digital file. This was an age when artists enjoyed vital and wide-ranging relationships with mechanical technologies.

A key turning point in the history of technology in the arts was the advent of photography. This technology enabled a new form of seeing, of freezing motion and making the invisible visible and the unknown known. New split-second exposure times made it possible to capture a moment, and photographic studies of animals in motion by Eadweard Muybridge led to the invention of the motion picture. Photography helped redirect artistic investigations of the world toward the expressive and the conceptual, opening up the new field of abstraction in painting and sculpture, an

aesthetic regime that still reigns today.

Another watershed moment was the global conflict of the Second World War. After 1945, certain artists, including Nam June Paik and John Chamberlain, made machines themselves into works of art. Especially in Paik’s case, this effectively transformed the artist into a kind of “artist-engineer.” It was this transition that led to a rethinking of the nature of art itself. Now, art often incorporates anthropological elements, forcing us to ask questions like, “what is this work saying about the conditions of contemporary society?” This new realm—the conceptual—propels art to new heights of meaning and importance.

While we have focused our attention in this guide on the ways in which technological inventions have changed the course of art history, we have also situated individual artworks within their broader historical contexts, allowing us to draw more sweeping conclusions about history, culture, and human nature. Technology has always been a foundational part of human society. Witnessing its transformation in artworks across different cultures allows us to make important connections with perspectives distant from our own.

Timeline

DATE	EVENT
c. 400 BCE –	The camera obscura is invented.
c. 3 rd Century BCE –	Roman concrete is introduced, drawing from processes and recipes developed by the Greeks and Etruscans.
c. 200 BCE–200 CE –	The magnetic compass is invented in China.
c. 80–100 CE –	Mummy with an Inserted Panel Portrait of a Youth is created in the Fayum region of North Africa.
c. 126–28 CE –	<i>The Pantheon is constructed in Rome.</i>
c. 200 –	Chinese artisans have developed the technology for massive dragon kilns and are producing the world's first porcelain objects.
c. 1180 –	The use of the flying buttress at Notre Dame in Paris transforms Gothic architecture.
c. 1190 –	The use of a magnetic compass in Western Europe is recorded for the first time.
1221–30 –	Chartres Cathedral's South Rose Window is created in France.
1294 –	The Mongols conquer nearly all of Asia, which creates the largest land empire in human history.
1297 –	Wang Chen reintroduces the use of moveable type with his publication <i>Nung Shu</i> .
c. 1300 –	Chinese blue-and-white porcelain is refined by Yuan dynasty potters at Jingdezhen.
Early 15th Century –	<i>Jar with Dragon is created in China.</i>
c. 1400 –	The full-rigged ship is invented.
c. 1350–1400 –	The Renaissance begins, recovering and remaking ancient learnings in Europe.
1415–20 –	Filippo Brunelleschi conducts experiments with linear perspective.
1436 –	Filippo Brunelleschi's dome for the Duomo in Florence is completed.

c. 1440 –	Johannes Gutenberg develops a mechanical printing press that could apply pressure to the inked surface of metal letter type and a print medium such as paper or cloth.
1444 –	The Atlantic slave trade begins when Portuguese traders bring the first large number of enslaved Africans to Europe.
c. 1450 –	Cristallo glass is invented in Venice.
16-17th Centuries –	Benin Plaque with Oba is created in the Kingdom of Benin.
c. 1450–53 –	Fra Filippo Lippi paints <i>The Annunciation</i> in Florence.
1492 –	Christopher Columbus sails to the Americas.
1497 –	Vasco da Gama sails from Europe to India by rounding Africa's Cape of Good Hope.
1514 –	Albrecht Dürer engravings his print <i>Melencolia I</i> in present-day Germany.
1527 –	Rome is sacked by the troops of Charles V, Emperor of the Holy Roman Empire.
c. 1545 –	<i>The Behaim Beaker</i> is created in Venice.
c. 1623–25 –	Artemisia Gentileschi paints <i>Judith and her Maidservant with the Head of Holofernes</i> in Rome.
c. 1685–1815 –	The Age of Enlightenment dominates intellectual and philosophical thinking in Europe.
1704 –	Prussian Blue is discovered by accident in Berlin.
1782 –	Marie-Louise-Elisabeth Vigée-Lebrun paints <i>Self Portrait in a Straw Hat</i> in Brussels.
1784 –	Charles Willson Peale's museum opens in Philadelphia.
c. 1786 –	The physiognotrace is invented.
c. 1803 –	Raphaelle Peale and Moses Williams create Moses Williams's silhouette in Philadelphia.
1825 –	The first locomotive-hauled public railway in the world opens in England.
1827 –	Nicéphore Niépce records <i>View from the Window at Le Gras</i> in France.
1827 –	The first railroad line is active in France.
c. 1830 –	Some of the earliest railroad tracks are active in the U.S.
1832–33 –	Antoine Hércules Romuald Florence develops early photographic techniques in Brazil.
1839 –	The daguerreotype makes its debut.

1841 –	The metal paint tube is invented.
c. 1855 –	An unknown artist records Frederick Douglass's daguerreotype.
1861–65 –	The American Civil War takes place.
1874 –	Claude Monet paints <i>The Bridge at Argenteuil</i> outside Paris.
1878 –	Eadweard Muybridge photographs <i>A Horse in Motion</i>, “Sallie Gardner” in California.
1879 –	Muybridge invents the zoopraxiscope.
1897 –	In Benin, British colonialist forces invade and burn Benin City and loot hundreds of metal sculptures from the royal palace.
1908 –	Production of the Ford Model T begins in Michigan.
1910 –	McKim, Mead, and White's Pennsylvania Station is completed in New York City.
1914–18 –	World War I takes place.
1927 –	Television is exhibited to the public for the first time.
c. 1935–38 –	Berenice Abbott photographs <i>Penn Station, Interior</i> in New York.
1939–45 –	World War II takes place.
1956 –	The Interstate Highway Act creates a 41,000-mile system of national highways in the U.S.
1962 –	John Chamberlain creates <i>Velvet White</i>.
1965 –	Nam June Paik creates <i>Magnet TV</i>.
2007 –	Repatriation discussions begin between the Nigerian and British governments to return the Benin bronzes to Africa.
2025 –	Projected opening date for a new museum in Nigeria, called the Edo Museum of West African Art, which will display a collection of repatriated Benin bronzes

Glossary

Abbot Suger – (1081–1151) influential church official, statesman, and historian in Gothic France; played an important role in the popularization of Gothic architecture and the centralization of the French Kingdom

Abstract Expressionism – a type of abstract art, usually oil on canvas, characterized by gestural brushstrokes and the impression of spontaneity; flourished in New York during the 1950s and 1960s and came to dominate art production internationally

ashlar masonry – finely cut stone construction; either an individual stone that has been worked until squared or a structure built from such stones

avant-garde – adopted from the French military term for “advance guard;” refers to modern, forward-looking artists who break with convention to create innovative modes of expression that are unorthodox, experimental, and radical

Baroque – predominant style in art, architecture, and music in seventeenth-century Europe; characterized by dynamism and theatricality

bone china – a kind of British porcelain imitating the Chinese original; made by incorporating ashes from animal bones; it was mass-produced by industrial machines.

burin – in engraving technology, the tool used to cut lines into a metal plate of copper or zinc; comprised of a steel shaft with a diamond-shaped tip

camera obscura – from the Latin for “dark chamber,” an optical tool that in its earliest iteration was a darkened room with a tiny opening in one wall that acted like a lens, focusing an upside-down image of the scene outside onto the opposite wall, which could then be traced by an artist

canvas – a strong, coarse cloth made from hemp, flax, cotton, or a similar yarn; used as a surface for oil painting beginning in the sixteenth century

coffers – the sunken square decorative panels on a dome or ceiling used to lessen its weight without corrupting its structural integrity

colonnade – a straight row of columns supporting a roof, entablature, or arcade

complementary colors – colors that are opposite one another on a color wheel: red and green, violet and yellow, blue and orange; a key philosophy in Impressionist color theory

cristallo glass – the first perfectly clear glass; invented in Venice and proliferating starting in the middle of the fifteenth century; named for the vaunted *rocca di cristallo* (“rock crystal” in Italian), which it resembled in clarity and colorlessness

Cubism – a worldwide art movement that abandoned linear perspective to break down the picture plane; part of the larger move to abstraction in the fine arts that responded to modern life by rejecting illusionism and fracturing the picture plane

daguerreotype – the world’s first publicly available photographic process, invented by Louis Daguerre and introduced in 1839; also describes the photograph created by this process, which employs an iodine-sensitized silvered plate and mercury vapor to fix the image

Daoism – a philosophy traditionally credited to the elusive Chinese sage Laozi that envisions a dynamic, life-sustaining energy flowing through the universe; this energy can fill artists if they are open, flexible, and yielding.

dragon kiln – a traditional Chinese form of kiln used for making ceramics and named for its long and thin shape

en plein air – the act of painting outdoors; French for “in the open air”; made popular by Impressionist painters who moved outside to capture fleeting light effects in the natural landscape

encaustic – a technique wherein an artist mixes colored pigments with wax (usually beeswax) and applies the colored mixture to a smooth surface

engraving – in printing technology, a technique for embellishing metal surfaces with incised pictures that can then be inked and printed on paper

Enlightenment – a European intellectual movement of the late seventeenth and eighteenth centuries emphasizing reason and individualism over tradition

Fayum portraits – Also called “mummy portraits,” these naturalistic painted portraits were made in encaustic on wood panel and attached to the mummified bodies of upper-class citizens from Roman Fayum in Egypt.

flashing – fusing one layer of colored glass onto another

flying buttress – an arch that extends from the upper portion of a wall to a pier in order to convey its lateral thrust into the ground; first used at the Gothic Cathedral of Notre-Dame in Paris to hold the cathedral’s thin, tall walls in place by supporting them from the outside

fresco – a painting done rapidly in watercolor on wet lime plaster, which is applied to a wall or ceiling to become physically integrated into the building

gesso – the white paint mixture used to prime the rough surface of a canvas before it is painted

Giorgio Vasari – (1511–74) an important Renaissance-era artist and biographer

glaziers – glassworkers; specifically, those who fit glass pieces into windows and doors

hierarchic scale – the purposefully unrealistic rendering of figures in a narrative scene to emphasize a single figure’s prominence, commonly Christ (i.e., sizing human figures based on status)

horizon line – In linear perspective, the horizon line marks the landscape’s horizon in a scene’s distant background.

impasto – from the Italian verb *impastare*, meaning to knead or to paste; refers to the technique of thickly laying paint onto the canvas so that it stands out from the surface

kaolin clay – a special clay used to make fine porcelain; lauded for its purity, whiteness, translucency, and strength; naturally occurring in Jingdezhen, Jiangxi province, China

lancet window – a slender, pointed window, common in Gothic architecture

latent image – an image registered on the surface of a photographic plate during exposure but invisible to the naked eye before further chemical processing

lost-wax casting – a method of making metal sculpture using a clay core and wax coating placed in a mold

lunette – the semi-circular shape used to describe panel paintings or distinguish the arched aperture of a window or domed ceiling

manillas – bracelets produced in the Low Countries (modern Holland) during the sixteenth and seventeenth centuries, traded throughout West Africa as a kind of currency, and melted down by the brass workers of Benin to make many panels that today constitute the “Benin bronzes”

matrix – in printing technology, the slab of wood or metal that is carved with a design, rolled with ink, and transferred to paper or cloth to make multiple copies of the same image

mummification – the embalming and wrapping of a body for preservation

negative – in photography, an image on transparent glass or plastic film wherein the colors are reversed; used to make a positive, which is most commonly printed on paper

oculus – the circular opening at the apex of a dome; means “eye” in Latin

oil paint – a paste made with ground pigment for color and a drying oil such as linseed oil; used by artists to create glossy and layered images of great complexity

orthogonals – in linear perspective, the diagonal lines drawn from the edges of the picture to the vanishing point to create a structural grid organizing the image and determining the size of objects within the image’s illusionistic space

pantograph – an instrument for copying a drawing or plan at a different scale by a system of hinged and joined rods

pastel – a type of colored chalk that is applied to textured paper to achieve a delicate, filmy image

pediments – these gables, usually triangular in shape, are placed above the horizontal lintel of a doorframe

performance art – an artwork created through actions

executed by the artist or other participants; may be witnessed live or through documentation

phrenology – a pseudoscience involving the measurement of bumps on the skull to predict a person's traits

physiognotrace – a mechanized contraption that copied a sitter's traced profile onto white paper to produce a silhouette in miniature; the term derives from the machine's action (to trace) and the subject it reproduced (physiognomy, i.e., a person's facial features or expression)

porcelain – a ceramic material made by heating clay in a kiln to temperatures between 2,200 and 2,600 °F; mastered by craftspeople in China some two thousand years ago; can be modeled into intricate forms and painted

portico – a porch leading to the entrance of a building with a roof structure over a walkway, supported by columns

positive – in photography, an image made from a negative in which the tones are re-reversed and thereby corrected

Precisionism – among the first modernist art movements to be developed in the United States; contributed to the rise of American Modernism following World War I; borrowing from Cubism, Precisionism celebrated the new American landscape of skyscrapers, bridges, and factories in their most essential geometric forms, focusing on mechanical forms.

relief – From the Latin *relevo*, “to raise,” relief is a sculptural method in which molded pieces are bonded to a solid, planar background made of the same material; **high relief** indicates forms that emerge to a significant degree from the background; **low relief** indicates forms that are shallower and do not emerge with as much definition from the background plane.

repatriation – the process of returning a thing or a person to its country of origin; in art history, art objects are repatriated following periods of war or historic acts of seizure conducted under colonialist or imperialist regimes.

revetment – in architecture, a facing of impact-resistant material such as stone or concrete that covers the surface of a structure to protect it against wear

Rococo – an elaborately ornamental late Baroque style of decoration prevalent in eighteenth-century Europe; notable for excess, sinuous lines, pastel colors, and gilt furniture

rose window – decorated circular stained-glass window favored by architects during the High Gothic period; notable for rich decorative motifs formed by the window's dividing segments

rotunda – a building with a circular ground plan, often covered by a dome

stipple engraving – in printing technology, a design made by a series of small dots engraved on the metal surface of the matrix

tenebrism – strong use of contrasting light and dark in a painting's palette; a hallmark of the Baroque style in painting

underglaze painting – in ceramics, the process wherein pigment (historically usually cobalt) is painted directly onto the surface of an unfired porcelain vessel before a thick clear glaze is applied over the top and the vessel is fired

vanishing point – in linear perspective, the vanishing point is at the center of the horizon line; it determines the center point for the radiating orthogonal lines.

wet-plate process – In photography, a wet-plate photograph allowed unlimited paper prints (the positive) to be made from a single exposure (the negative, the product of the wet-plate process); this technology replaced the daguerreotype by the mid-nineteenth century.

woodcut – a relief printing technique wherein a design is carved into the surface of a block of wood, inked, and printed on paper or cloth; it is the oldest of all printing technologies.

zoopraxiscope – a lantern designed by Eadweard Muybridge that projected images from photographs printed on a rotating glass disc onto a screen in rapid succession; when projected via light at a high speed, the images created the illusion of a continuously moving picture.

Notes

- 1 NFTs are unique digital identifiers that cannot be copied, substituted, or subdivided, and are used to certify authenticity or ownership of a digital file.
- 2 Lechtman and Hobbs, “Roman Concrete and the Roman Architectural Revolution.”
- 3 Fine Licht, “The Rotunda in Rome: A Study of Hadrian’s Pantheon.”
- 4 Davies and Janson, *Janson’s History of Art*, 202.
- 5 Berger, *The Shape of a Pocket*, 53.
- 6 Ibid., 54.
- 7 Adams, *A History of Western Art*, 201.
- 8 Thophilus, *On Divers Arts*.
- 9 Hugh of Saint-Victor, *Speculum de mysteriis ecclesiae*, Sermon 2.
- 10 Durand, *The Symbolism*, 28.
- 11 Stones, “Chartres, Cathedral of Notre-Dame.”
- 12 *Masterpieces of the Metropolitan Museum of Art*, ed. Barbara Burn, 180.
- 13 The “Age of Discovery” is a loose term that seeks to identify a general historical phenomenon rather than a perfectly delineated, cohesive, or deliberate movement. The dates given here reflect the period that begins with Columbus landing in present-day Bahamas (1492) and ends with Miguel López de Legazpi establishing the first Spanish settlement in the East Indies when his expedition successfully crossed the Pacific from Mexico, arriving in the Philippines in 1565. This historic crossing would become the favored route used by Manila galleons crossing from China to the Americas. It marks the start of truly global trade by connecting Europe, the Americas, and China via trans-Pacific and trans-Atlantic routes.
- 14 Alberti, *De Pictura*.
- 15 Gentileschi, “Letter to Don Antonio Ruffo,” November 13, 1649, in *The Voices of Women Artists*, ed. Slatkin.
- 16 See Garrard, *Artemisia Gentileschi*.
- 17 Turner, “Aesthetics of Venetian Cristallo,” 115.
- 18 Bayer *Art and Love in Renaissance Italy*, 96–97.
- 19 Neri, *The Art of Glass*, 1612.
- 20 Mackenzie, *Non-Western Art*, 20.
- 21 Apley, “African Lost-Wax Casting.”
- 22 Frum, “Who Benefits When Western Museums Return Looted Art?”
- 23 Ball, *Bright Earth*, 241–44.
- 24 Vigée-Lebrun, *Memoirs*.
- 25 Laforgue, *L’Impressionnisme*.
- 26 Ball, *Bright Earth*, 179.
- 27 Pierre-Auguste Renoir as quoted in Renoir, *Renoir: My Father*, 69.
- 28 Claude Monet as quoted in Perry, “Reminiscences of Monet.”
- 29 Holmes, “The Stereoscope and the Stereograph,” 738–9.
- 30 As quoted in Gernsheim, *Daguerre*, 82–85.
- 31 Douglass, “A Tribute for the Negro.”
- 32 Douglass, “Lecture on Pictures.”
- 33 As cited in Whitney Museum, *Frames of Reference*, 85.
- 34 Berenice Abbott, “Changing New York” project proposal, New-York Historical Society, 1932, excerpted in O’Neal, *Berenice Abbott: American Photographer*, 16–17.
- 35 Berman, “The Unflinching Eye of Berenice Abbott,” 88.
- 36 Bellion, *Citizen Spectator*, 222.
- 37 For the full story of Moses Williams and the physiognotrace, see DuBois Shaw, “Moses Williams, Cutter of Profiles: Silhouettes and African American Identity in the Early Republic” in Shaw, *Portraits of a People*, 45–55.
- 38 Peale, “The Physiognotrace,” 307–8. Note that Raphaelle Peale, who is credited along with Moses Williams for this silhouette, was an artist who was another of Charles Willson Peale’s sons.
- 39 Brigham, *Public Culture*, 70.
- 40 Peale, “The Physiognotrace,” 307–8.
- 41 Solnit, *Motion Studies*.
- 42 Barnouw, *Tube of Plenty* and Fisher, *Tube: The Invention of Television*.
- 43 Stephens, “History of Television.”
- 44 Hanhardt, *The Worlds of Nam June Paik*.
- 45 Decker, *Paik Video*, 60.
- 46 Paik, *Electronic Art III*, 1.
- 47 Foner, *The Reader’s Companion to American History*, 64–68.
- 48 John Chamberlain Estate “Bio.”
- 49 Chamberlain et al. *Choices*, 18.
- 50 Rauschenberg, “Interview at SFMOMA, May 6, 1999.”

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