COCHINEAL RED *The Art History of a Color*

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The Art History of a Color

Elena Phipps

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On the cover: Coca bag. Peru, Moche, 5th–6th century (see fig. 32, page 19). Inside covers: Ceremonial mantle (detail). Bolivia, Aymara, 18th–19th century. Warp-face plain weave cochineal-dyed camelid hair. The Metropolitan Museum of Art, Bequest of John B. Elliott, 1997 (1999.47.251)

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Director's Note

Cultures the world over and throughout history have valued the color red. Whether in dyes, pigments, or inks, brilliant red has been one of the most difficult hues to create. When the Spanish returned from Mexico in the 1520s with samples of a dye that produced the most intense and stunning red Europe had ever seen, it understandably caused a stir, and by 1550 the Spanish flotillas were hauling tons of the crimson treasure to Europe. Cochineal, produced from the dried and pulverized bodies of a cactus-eating scale insect, was in abundant supply and easy to use, and it quickly supplanted all other red dyestuffs. This issue of the *Bulletin* traces the spread of cochineal red from the Americas, where Mexican and Andean weavers had for centuries been using it to create ritual and ceremonial textiles in deep shades of red and pink, to Europe and then to the Middle East and Asia.

Using examples from the Museum's collections, author Elena Phipps has been able to contextualize cochineal's global role in the history of art and commerce. In order to identify concrete instances of the use of red dye across a wide swath of history, more than one hundred textiles selected from the Metropolitan's vast holdings, which range in date from the prehistoric era to the present day, were subjected to scientific analysis to determine the dyes they were colored with. This unusual presentation could only have been accomplished at The Metropolitan Museum of Art, not only because of the breadth and depth of its collections but also because of the expertise and creativity of its curatorial, conservation, and scientific staff. Projects like this one—a focused examination of the creation and use of a single color across time and space—represent the Metropolitan's commitment to furthering the understanding of art in all its forms from a variety of perspectives.

Thomas P. Campbell
Director, The Metropolitan Museum of Art

Preface

As a conservator and textile scholar at The Metropolitan Museum of Art for more than thirty years, I have had the rare privilege of having first-hand access to the Museum's vast textile collection. While handling the textiles and examining them under the microscope, I have often been overwhelmed by their power to communicate their own stories. The same physical qualities that make each textile unique and give it beauty—fiber, dye, weave structure, texture, pattern, and design—also give it historical relevance and locate it in a specific time and place. Designs that originate in one culture may be adapted to suit other purposes in another. Some fibers are found only in one particular geographic region; others have been traded across the globe. Artisans in one area may spin yarns in one direction, while their neighbors do the opposite. Each textile thus carries the cultural signature of the people who created it.

The catalyst for this *Bulletin* devoted to the art history of cochineal red was a paper entitled "Color in the Andes: Inca Garments and 17th-Century Colonial Documents" that I presented to the annual meeting on Dyes in History and Archaeology at the Royal Museum in Edinburgh in 2003. I had long been fascinated by the geographic and cultural significance of colors in textiles, but my research on Inca dyes led to a special interest in the color red and the cochineal insect used to produce it. In writing this *Bulletin* I have relied extensively on the work of the many scholars who have also been captivated by the subject, which encompasses not just art and history but also geography, economics, and science. Pliny the Elder wrote about natural red dyes in the first century A.D., and since then specialists in a number of fields have examined red dyes in general and cochineal in particular from different points of view. A manual coauthored by Jean-Baptiste Colbert, Louis XIV's finance minister, is just one of several treatises on dyeing written between the early seventeenth century and the dawn of the twenty-first that not only discuss cochineal's history and the technical aspects of its use as a dye but also include recipes. In 1956 R. J. Forbes presented the history of dyeing in the context of the history of technology, and in 1977 R. A. Donkin pioneered an extensive study focused on cochineal from the Americas, basing much of his work on archival documents. The economic impact of trade was thoroughly examined in 1948 and 1951 by Raymond Lee, who utilized the shipping records of the East India Company as a primary source. Historian Amy Butler Greenfield presented the story of cochineal in her 2005 book titled *A Perfect Red*. And in 2007 Dominique Cardon, a specialist in archaeological textiles, contributed a monumental work on the history and science of natural dyes.

To prepare this *Bulletin* I undertook a broad examination of the immense textile collection of the Metropolitan in conjunction with scientists in the Museum's Department of Scientific Research and other professionals. During the 1980s and 1990s a number of textiles in the Museum had been tested to determine the source of the red colorants used in them. For this *Bulletin*, between 2007 and 2009 more than one hundred additional samples were analyzed with high performance liquid chromatography, X-ray fluorescence spectroscopy, surface-enhanced Raman scattering, and other techniques. Won Ng, then at the Metropolitan, and Jan Wouters, of the Institut Royal Patrimoine Artistique in Brussels, conducted the early tests. Nobuko Shibayama analyzed the majority of the one hundred textiles in 2007–9, and I am most grateful to her. Silvia Centeno and Mark Wypyski utilized their particular expertise to examine some of the samples. Marco Leona, who heads the Department of Scientific Research and who was particularly supportive of this project, analyzed the quirky and problematic objects and those from which only microscopic samples could be taken. The results of their enormous effort formed the building blocks for this essay, allowing it to take a more concretized view of the process of history and to demonstrate how that process plays out in the actual making of works of art. Reading about a seventeenth-century ship's log, for example, that documents the shipment of thousands of tons of cochineal insects from Mexico to Spain is enlightening, but being able actually to look at textiles known to have been dyed with cochineal during the same period is even more valuable in understanding how and where the dyestuff emerged as the primary source of the color red. This approach is possible only with collaboration between art historians, scientists, and conservators, and The Metropolitan Museum of Art is uniquely poised to foster such a collaborative effort to broaden knowledge about the works of art in its collections.

In my work on this *Bulletin* I was assisted by a number of curators and conservators in several departments who not only allowed me to examine their collections and select objects to be sampled but also were generous with their expertise and knowledge. Among them are Julie Jones, Alisa LaGamma, Christine Giuntini, James Watt, Joyce Denney, Amelia Peck, Ian Wardropper, Johanna Hecht, Melinda Watt, Elizabeth Cleland, Peter Barnet, Helen Evans, Dorothea Arnold, Catharine Roehrig, Christine Lilyquist, Kenneth Moore, Donald La Rocca, Morihiro Ogawa, Joan Aruz, Kim Benzel, Harold Koda, Christine Paulocik, Sheila Canby, Stefano Carboni, Navina Haidar Haykel, Dorothy Mahon, Michael Gallagher, Lisa Pilosi, Ann Heywood, Gary Tinterow, and Keith Christiansen. I was helped as well by the staff of the Textile Conservation Department: Florica Zaharia, Midori Sato, Janina Poskrobko, Tina Kane, Emilia Cortes, Min Sun Hwang, Kristine Kamiya, Cristina Carr, Kathrin Colburn, and Maya Naunton, among others, and of the Antonio Ratti Textile Center, who provided constant access to the collection: Giovanna Fiorino-Iannace, Seta Wehbé, Toma Fichter, Eva Labson, and Tae Smith. Early on in its development, Thomas Campbell, then curator of European Sculpture and Decorative Arts, encouraged this project, and I thank him for his support. Nobuko Kajitani, formerly conservator in charge of Textile Conservation, was instrumental in stimulating my interest in historical dyes and their identification. I thank Barbara Anderson and the Getty Research Institute for facilitating my six weeks of dedicated research in Los Angeles. I am also grateful to Philippe de Montebello, who when presented with the proposal for this project remarked that he was familiar with cochineal insects, which often landed in his tea during the summers he spent in the south of France. Finally, I and all of us who have put together this *Bulletin* are indebted to John P. O'Neill, whose enthusiasm and support enabled its realization.

Elena Phipps

Nopal planta que se cria en la America y produce la Grana &c.

Cochineal Red: The Art History of a Color

From antiquity to the present day, color has been embedded with cultural meaning. Its perception and use have been influenced by many factors, including the actual material source of the colorant itself. Red—associated with blood, fire, fertility, and life force in many cultures throughout the world—has always been one of the most highly prized colors, in part because it is among the most difficult to achieve.

The first colorants from nature to be exploited for artistic, ritual, and magical use were ochers and other mineral pigments, or red earth. Neolithic cave painters like those who covered the walls of Lascaux, Niaux, and Chauvet in southern France with animal-populated landscapes used orange-red ocher to highlight the scenes they drew with black charcoal, adding drama and power to the images. In the second millennium B.C. Egyptians saturated special linen burial cloths with deep orange-red hematite (iron oxide) or red ocher mineral earths. The mummified body of Wah, for example, a storehouse manager for a wealthy official who died in about 1975 B.C., was wrapped in layer upon layer of undyed linen cloth, the layers interspersed with amulets and funerary jewelry of blue faience and personal jewelry of gold, silver, lapis lazuli, and other semiprecious stones. The outermost wrapping for the mummy was a special red-colored linen cloth (fig. 1) inscribed along its edge "Temple linen to protect," possibly evoking the religious belief in the protective power of red and also reminiscent of Osiris, who is referred to as the "lord of the red cloth" in the *Book of the Dead*.[1]

The red color on the Egyptian temple linen was produced by saturating the cloth in finely ground hematite, an iron oxide. Cinnabar, a mineral pigment of powdered mercury (mercuric sulfide), was also used in early cultures to create a bright orange red. Yarns colored with cinnabar form the red bands across the complex woven design on a fragment of silk from the Warring States period (ca. 475–221 B.C.) in ancient China (fig. 2).[2] Hematite, cinnabar, and other mineral pigments were also used in the Americas. Cinnabar red and hematite both highlight the carved and polished surfaces of the green jadeite masks of the Olmec peoples of the first millennium B.C. in Mesoamerica. On the fine example in the Museum's collection (fig. 3), traces of the red iron earth pigment are still visible in the crevices, providing a glimpse of its former state. And beginning about 1000 B.C. in South America, Peruvian artists drew representations of their gods and ritual beings on cotton fabrics using iron earth, as well as red lead and mercury pigments. (In many cultures, and particularly in the Americas, red was associated with death, and as both mercury and red lead are poisonous to the touch, their use in objects associated with rituals pertaining to death and the afterlife is all the more poignant, symbolic of the duality of life and death.) On textiles from about 400 B.C. that were preserved in the southern desert (see fig. 4), the composite intertwined snake and fanged deity images that demonstrate a complex symbolic visual language system are depicted with refined iron earth pigments.

Opposite: "The nopal plant that is grown in America and produces *grana* [insect dye]." *Reports on the History, Organization, and Status of Various Catholic Dioceses of New Spain and Peru* (1620–49), fol. 85. Newberry Library, Chicago (Vault Ayer MS 1106 D8 Box 1 Folder 15)

1. Linen cloth. Upper Egypt, Thebes, Tomb of Wah (Museum Excavations, 1920); Middle Kingdom, Dynasty 12, early reign of Amenemhat I, ca. 1981–1975 B.C. Linen, hematite; 96½ x 31½ in. (245 x 80 cm). The Metropolitan Museum of Art, Purchase, Rogers Fund and Edward S. Harkness Gift, 1920 (20.3.203a). This was the outer wrapping of Wah's mummy.

2. Textile fragment with stripes and confronted birds. China, Warring States period, ca. 475–221 B.C. Warp-faced compound plain weave silk, 5¼ x 9½ in. (13.4 x 24 cm). The Metropolitan Museum of Art, Purchase, The Vincent Astor Foundation Gift, 2002 (2002.558). The bright orange red is cinnabar.

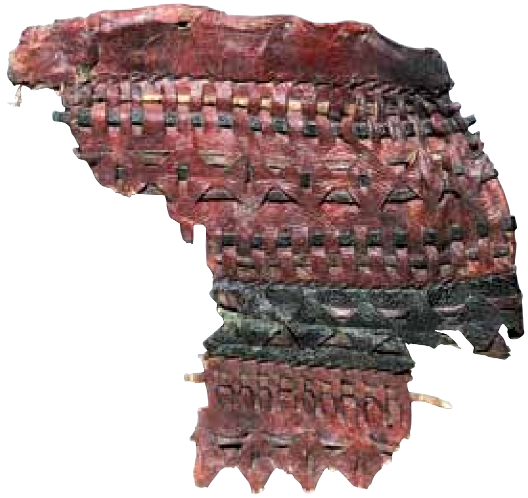
While mineral colors applied in powdered form to surfaces played an important role in textile production in early cultures, artisans of great creativity, resourcefulness, and intelligence eventually refined the art of dyeing cloth a bright red. The main sources for creating red color on cloth come from a variety of plants and animals, and these were used for dyeing textiles throughout the world. Among all the species of plants, only a few yield material suitable for making red colors. Although many plants, particularly those with red berries, produce red juices, most of them are not used for dyeing, as at best they make only a temporary stain. The roots and flowers of certain other plants yield an orange-red or pink color—strong, bright hues that bond with natural fibers to create permanent color. Madder (*Rubia tinctorum* and other related wild species), safflower (*Carthamus tinctorius*), and alkanet (*Anchusa tinctoria*) were used notably in Europe, Mesopotamia, and Asia. Among the earliest known occurrences of madder is in a fragment of a decorative polychrome border, probably from a leather quiver (fig. 5), from Egyptian Dynasty 11 (ca. 2124–1981 B.C.) that was found in western Thebes, presumably a Mesopotamian import. Madder dye was also found in a sixth-century Sassanian textile from the site of Shahr-i Qumis (fig. 6). The orange-hued root was used as an orangish red colorant throughout western Europe, in the Middle East in the Fertile Crescent, and as far east as western China, from at least the time of the Han dynasty (206 B.C.–A.D. 220). As a lake or pigment, it was also painted on the surfaces of early Greek and Roman ceramic figurines and vessels, and perhaps even glass (see fig. 7).

Heartwoods from tropical trees such as brazilwood or camwood from Southeast Asia, Africa, and South America were the source of a more purplish red dye. The Tyrian purple known throughout the ancient Mediterranean world was produced from mollusks of the genus *Murex*, which could yield a reddish purple as well as the deep bluish purple shades for which they are most famous (see fig. 8). Less known but as important was the shellfish purple dye obtained from a slightly different, American mollusk (*Concholepas concholepas* in Peru and *Plicopurpura patula* in Mexico and Guatemala). Like its Mediterranean counterpart it produced a range of color from red to purple.

The most brilliant crimson red dye, however, was obtained from a group of scale insects of the

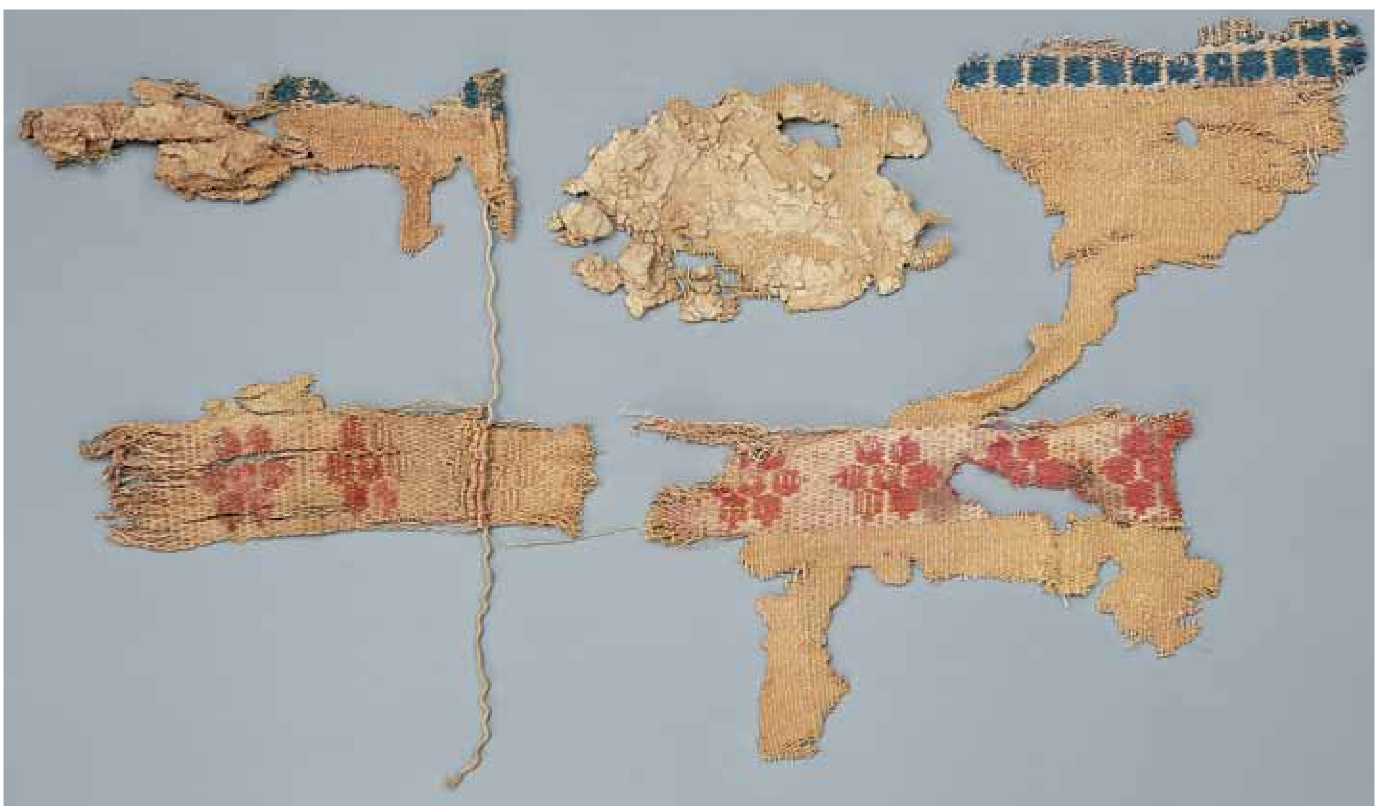
3. Mask. Mexico, Olmec, 10th–6th century B.C. Jadeite with traces of hematite, h. 6¾ in. (17.1 cm). The Metropolitan Museum of Art, Bequest of Alice K. Bache, 1977 (1977.187.33)

4. Textile fragment. Peru, Chavín, 4th–3rd century B.C. Cotton plain weave painted with refined iron earth pigments, 5¾ x 12¼ in. (14.6 x 31.1 cm). The Metropolitan Museum of Art, Bequest of Jane Costello Goldberg, from the Collection of Arnold I. Goldberg, 1986 (1987.394.704)



5. Fragment of a quiver(?).Upper Egypt, Thebes, el-Khokha, Tomb MMA 830 (Museum Excavations, 1911–12); Middle Kingdom, Dynasty 11, ca. 2124–1981 B.C. Leather, dyes (including red madder); 4⅜ x 5⅛ in. (11 x 13 cm).The Metropolitan Museum of Art, Rogers Fund, 1928 (28.3.5)

superfamily Coccoidea. The group includes several genera of dye-producing insects, called kermes, lac, and cochineal, that have been used since antiquity. Throughout history, there has been confusion regarding the identification of the different insects and the naming of the particular dyes they produce. The dried bodies of female insects of the genus *Kermes* (from the Arabic and Persian word for red or carmine, *qirmiz*, which derives from the Sanskrit *krimija*, meaning worm-made), particularly the species *Kermes vermilio* (often confused with *Kermes ilicus*, which was formerly called *Coccus ilicus*, from the Greek *kokkos*, or berry), were extensively traded throughout the classical world, primarily by the Phoenicians. (The ancient Egyptian term for red color, *dšr*, may have also referred to kermes, one of the dyes used for coloring leather imported into Egypt via Phoenician traders.) The insects feed on the leaves of a species of evergreen oak (*Quercus coccifera*, also called the kermes oak) that grows along the shoreline of the Mediterranean in southern Europe, northern Africa, and the Levant (see figs. 9, 10). Scarlet garments dyed with kermes are prescribed by Judeo-Christian ritual, and the dyeing of such garments with kermes—in Hebrew called *tola'at shani*, or "the worm that shines"—is



6. Textile fragments with bands of rosettes and pearls (reverse). Iran, Shahr-i Qumis (ancient Hecatompylos), Site VI, Room 23; Sassanian, 6th century. Weft-faced compound weave wool and cotton, dyes (including red madder); 9¼ x 16⅛ in. (23.5 x 41 cm). The Metropolitan Museum of Art, Purchase, H. Dunscombe Colt Gift, 1969 (69.24.35)

mentioned several times in the Old Testament.[3] In the first century A.D. Pliny the Elder listed "the red, that of the kermes," first among "fabrics which rival the colors of flowers" (*Natural History* 22 [8]). In an earlier chapter (3 [2]) Pliny had described kermes, or coccus, "a dye reserved for the military costume of our generals," as a berry that becomes a worm, a misconception that would persist until the cochineal insect was examined under a microscope and accurately described, first by Nicolaas Hartsoeker in 1694 (see fig. 11) and then, in even greater detail, by Antoni van Leeuwenhoek in 1704.

In the Middle East and central Asia, particularly in the flat grassland of the valley at the base of Mount Ararat, red dye produced from a different insect, of the species *Porphyrophora hamelii* (the genus name *Porphyrophora* means "purple bearers"; see fig. 12), was in use from at least 714 B.C., when the Assyrians under Sargon II invaded Urartu (Armenia). Although few examples have survived, ancient accounts of travelers to the region mention red-dyed garments. Armenian cochineal, as it is called today, was also used as a red pigment in illuminated manuscripts produced in Armenian monasteries in the Middle Ages.

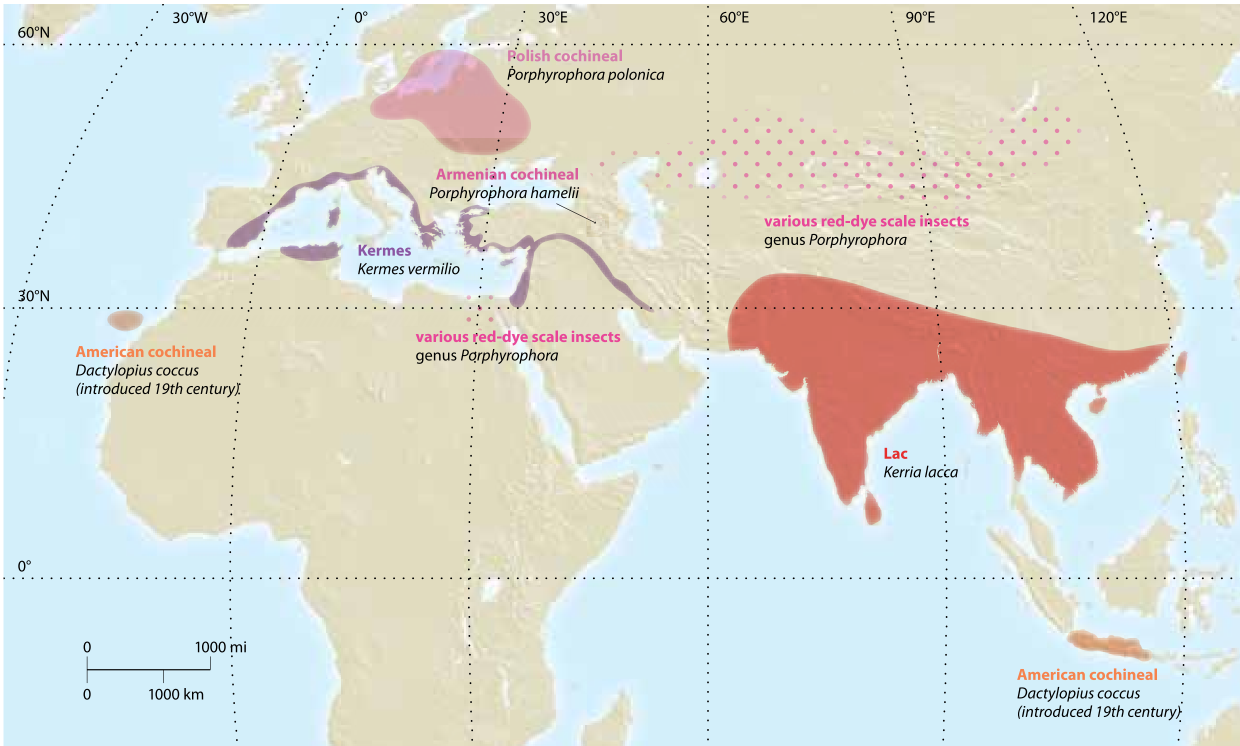
Eastern Europe was the source of another, related red-producing insect, *Porphyrophora polonica* (or *Margarodes polonicus*), known as Polish cochineal (fig. 13). This red dye is sometimes called Saint John's blood because the insects, which live in the roots of a native grass plant, *Scleranthus perennis* (knotgrass), hatch and emerge from the ground around June 24, the feast day commemorating the birth of Saint John the Baptist. The so-called Polish cochineal, along with other dye-producing insects of the genus *Porphyrophora*, is found in sandy areas in central and eastern Europe, Ukraine, Caucasus,Turkistan, and western Siberia.[4] Its use in antiquity has been documented in the frozen textiles from the fourth century B.C. that were found in southern Siberia at Pazyryk, among them a woman's garment dyed with a mixture of madder and Polish cochineal,[5] and by a central Asian textile band in the Metropolitan's collection that was embroidered with images of goats sometime between 200 B.C. and A.D. 100 (fig. 14).

In India and Southeast Asia yet another type of red-dye insect was found. Called lac (*Kerria lacca*), the insect lives on ficus and other types of trees and is sometimes referred to as stick lac because it attaches itself to branches and covers itself with a protective layer of a resinous substance that produces shellac. Like shellac, the deep red color produced from the insect itself was sought after and traded in antiquity. References to it appear in the ancient Sanskrit text on sorcery, the *Arthashastra* from the fourth to second century B.C. Lac dye that found its way along the trade routes from tropical Southeast Asia to eastern Iran or Sogdiana colors the brilliant pink spotted deer on a fragment of a caftan or robe that dates from the eighth or ninth century (fig. 15).

None of the beautiful red dyes produced from the Old World parasitic insects, however, could match the

7. Situla (wine bucket) with two handles. Greek, Hellenistic period, late 4th–early 3rd century B.C. Glass and silver with gilding and paint (madder?), h. 8 in. (20.4 cm). The Metropolitan Museum of Art, Purchase, The Bernard and Audrey Aronson Charitable Trust Gift, in memory of her beloved husband, Bernard Aronson, 2000 (2000.277). Optical microscopy shows a pink organic lake such as madder that could not be confirmed spectroscopically.

8. Roundel. Egypt, Coptic period, 3rd–4th century. Tapestry-weave wool and linen on linen ground, *Murex* purple dye; 8 x 13 in. (20.3 x 33 cm). The Metropolitan Museum of Art, Purchase by subscription, 1889 (89.18.174)



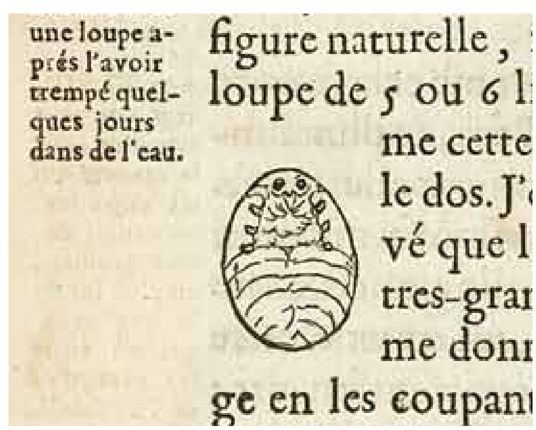
9. Habitats and later areas of cultivation of red-dye insects in Europe, the Middle East, Africa, and Asia

deep crimson color, ease of use, and abundant supply of the dye extracted from *Dactylopius coccus*, an American species of the same superfamily, Coccoidea, that yields more red colorant than any of them (see figs. 16, 17).[6] Both cultivated and wild forms of the tiny American parasite, called cochineal, feed on moisture and nutrients from the fruit-bearing prickly pear cactus (genus *Opuntia*) native to tropical and subtropical Mexico and South America (fig. 18). Biologists to this day have not agreed on where the insect originated, though recent studies of the genetics of the insect point to South America. Domestication resulted in larger insects that produced more colorant.

To make cochineal red, the colorant (mainly carminic acid) is extracted from the dried bodies of the female insects (fig. 19) in water. A mordant, or mineral salt, often alum (aluminum sulfate), is required to help bond the dye to the fibers. Other additives such as acids and alkali have traditionally been used to shift the naturally bright pink hue of cochineal to deep crimson, purple, or black (see fig. 20). This practice, artfully executed by Andean dyers in the highlands of Peru, Bolivia, and Ecuador in the centuries before the Spanish conquest, was described in 1653 by Bernabé Cobo, a Spanish Jesuit missionary who lived in

10. Female kermes insects on an oak leaf, southern France, 2008

11 (far right). A cochineal insect as seen under a microscope. Nicolaas Hartsoeker, *Essay de Dioptrique* (Paris, 1694), sect. 1, p. 52. New York Public Library, Science, Industry and Business Library, Astor, Lenox and Tilden Foundations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12. *Porphyrophora hamelii* (Armenian cochineal). J. F. Brandt, *Naturhistorische Bemerkungen über Wurzelcochenille im Vergleich zur mexicanischen* (1833), fig. 1

13. Life cycle of the Polish cochineal (*Porphyrophora polonica*). Johann Philip Breyn, *Historia naturalis cocci radicum tinctorii quod polonicum vulgo audit* (1731), loose plate at front. Academy of Natural Sciences, Philadelphia, Ewell Sale Stewart Library and the Albert M. Greenfield Digital Imaging Center for Collections

14. Fragment of a textile band with goats. Central Asia, 2nd century B.C.–1st century A.D. Plaited wool dyed purple with Polish cochineal, wool and cotton embroidery; 7 x 1½ in. (18 x 3.8 cm). The Metropolitan Museum of Art, Purchase, Friends of Inanna Gifts and Rogers Fund, 2000 (2000.507c). This is one of four fragments.

Mexico and Peru from 1599 until his death in 1657, in his *Historia del Nuevo Mundo* (History of the New World).[7]

Cochineal red was known as a dye in Mexico and South America at least as early as the second century B.C. and was used profusely by Precolumbian peoples. It colored special ritual and ceremonial textiles worn by rulers in both Mexico and Peru and was an important tribute item in the medieval economies of Latin America. Little is known about the use of cochineal in Mexico prior to the arrival of the Spaniards in the 1520s, due to the paucity of textiles that have survived from before that time. Some of the small fragments of early textiles that have been found in Mexico in dry caves or underwater contain color, but for the most part they have not undergone scientific analysis to identify their dye components. What does remain, however, apart from rare examples of dyed featherwork, is evidence of the use of cochineal as a pigment in painted native codices, maps, and tribute documents.

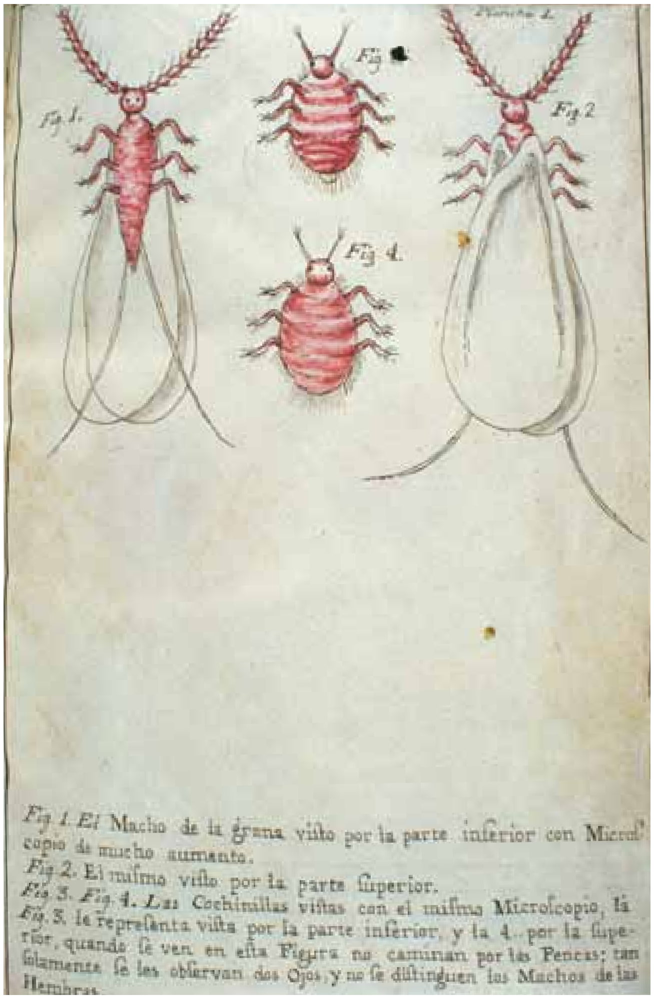
One of the most important Mexican codices, the early sixteenth-century *Matrícula de tributos* (Tribute List), documents the tribute being paid to the Aztec Empire, the Triple Alliance of the city-states of Tenochtitlán, Tlacopán, and Texcoco, at about the time of the death of the ninth Aztec emperor, Moctecuhzoma II (Montezuma), in 1520, soon after he welcomed Hernán Cortés and his army to Tenochtitlán.[8] The folios of the *Matrícula*, drawn on native *amatl* (bark) paper, provide a visual record of the tribute owed to the ruler, depicting both the types of goods—gold, feathers, cotton mantles, precious dyestuffs—and the quantities paid. The bags of dried cochineal insects have red spots on them and are tied at the top. The amount due is glossed as a flag that serves as a number glyph corresponding to 20. Two regions in central Mexico were responsible for considerable payments in

15. Fragment of a caftan or robe with deer in a pearl roundel. Eastern Iran or Sogdiana, 8th–9th century. Compound twill weave silk (*samit*), the bright pink dyed with lac; 13⅜ x 17⅜ in. (34 x 44 cm). The Metropolitan Museum of Art, Purchase, Rogers Fund, by exchange, 2006 (2006.472)

16. Habitats and areas of cultivation of cochineal in the Americas, from the 16th to the 19th century

cochineal (see figs. 21, 22): The Mixtec people of the region called Coaixtlahuacan, northeast of Oaxaca, were to give 40 sacks (indicated by the two flagged bags) of cochineal every year, along with more than 2,000 mantles and 400 cloths of various types, 20 jade belts, 800 quetzal feathers, and bags of gold and other goods. The Zapotec people of the region of Coyolapan, in the central Oaxaca Valley, were to contribute 20 bags of *grana cochinilla* every eighty days, along with 400 woven covers, 800 plain mantles, and 20 gold disks.

Sometime after the manuscript was created, the folios of the *Matrícula* were annotated by another hand to indicate the Spanish equivalents of the tribute amounts, now due to the Spanish administrators. Next to the cochineal sack on the Coyolapan page (fig. 22), for example, is written "Un Zurron de Grana," *ʒurrón* being the term for the leather bags that were used for shipping the dyestuff to Spain. Each *ʒurrón* held approximately 125 pounds. To sell and transport cochineal, the Aztecs made flattened cakes of dried insects held together with clay or flour that they called *nocheʒtlaxcalli* (from



17. Front and back views of male (with wings) and female (wingless) cochineal insects. José Antonio de Alzate y Ramírez, *Memoria sobre la naturalesa cultivo y beneficion de la grana* (Mexico City, 1777), pl. 1. Vellum, h. 12¼ in. (31 cm). Newberry Library, Chicago, Edward E. Ayer Manuscript Collection (Ayer MS 1031)

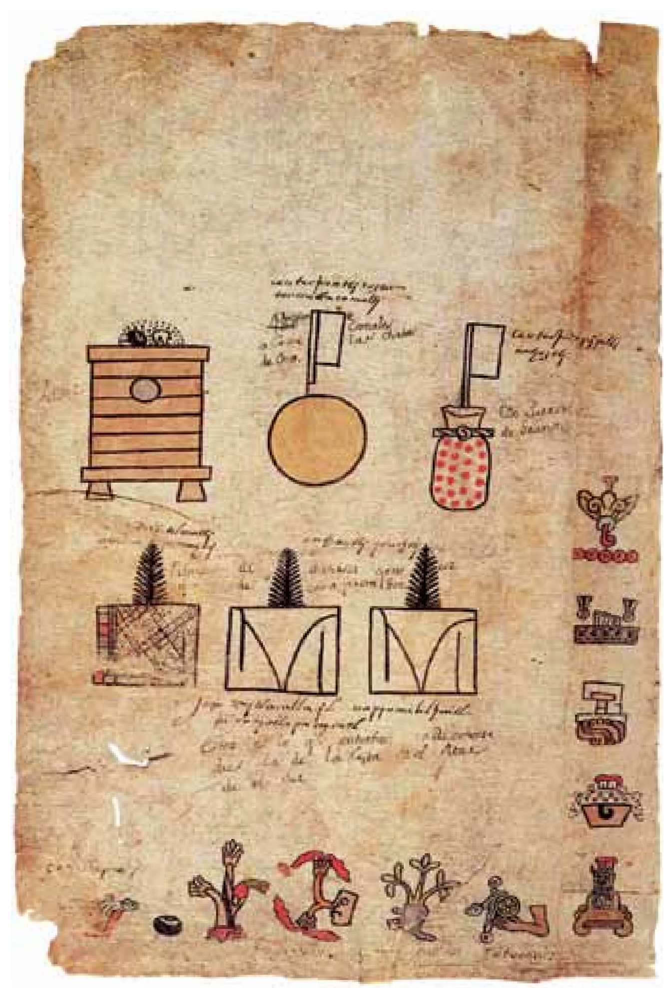
18. Wild cochineal insects (*Dactylopius silvestre*) on a cactus pad, southern California, 2009

19. Dried cochineal insects (*Dactylopius coccus*) collected in Peru, 2008

their word for cochineal, *nocheztli*). Franciscan friar Bernadino de Sahagún documented the practice in the fourteen-volume *Historia general de las cosas de Nueva España* (General History of the Things of New Spain, commonly known as the *Florentine Codex*) that he and a group of native scholars compiled in Nahuatl, the language of the Aztecs, and Spanish between about 1540 and 1585 (see fig. 23).

Another Spaniard, Gonzalo Gómez de Cervantes, documented the cultivation, harvesting, and drying of cochineal insects in Mexico in a report he prepared in 1599 for the viceroy of New Spain, Don Luis de Velasco, who had specifically requested the information. In his "Relación copios del beneficio de la grana cochinilla" (Copious Account of the Cultivation of Cochineal) Gómez de Cervantes described in detail the raising and planting of the nopal, or prickly pear, cactus that is the insects' host and the seeding, or transplanting, of the cochineal eggs onto the cactus with a *coa*, a brush made of fox hair (fig. 24). The tiny seedling eggs became attached to the fine hairs of the thin tool, which was gently brushed onto the surface of the cactus pad. The "painting" of the seeds started from the top, or north, side of the cactus, and when the nymphs hatched they found their way to the lower, or south, side of the pad, where they were more protected. Gómez de Cervantes wrote as well of the methods for caring for the cacti, and he identified the enemies of the cochineal, which include birds, worms, and chickens both native and Spanish (see fig. 25). He described the harvesting of insects, or *grana*, that have "grown fat in the sun to the size of one fat lentil" by removing them from the cactus pads into bowls the size of "half an orange" with a small spoon held in the right hand. Of the five ways to kill and dry the *grana* (sun, boiling in water, heating in a double-boiler,

20. Samples of silk cloth dyed with cochineal, showing the many different hues that can be achieved by adding mordants and other modifiers to the dyebath



21, 22. *Matrícula de tributos* (Mexico, early 16th century), fol. 23 (below left): annual tribute owed by the towns in the Coaixtlahuacan region in the northern part of the state of Oaxaca to the Aztec Empire, including 40 bags of *grana cochinilla* (indicated by two red-spotted bags), equivalent to two *zurrónes*, or Spanish leather sacks; fol. 24 (right): tribute owed every 80 days by the towns of the Zapotec region of Coyolapan in the central part of Oaxaca, including 20 bags of cochineal. Biblioteca Nacional de Antropología y Historia, Mexico City (Codex 35-52)

23. Sellers of cakes, or *tortillas*, of cochineal. Bernadino de Sahagún (Spanish, 1499–1590), *Historia general de las cosas de Nueva España* (Mexico, ca. 1540–85), fol. 369r. Biblioteca Medicea Laurenziana, Florence (Mediceo Palatino 220)

shaking while heating in an oven, and heating on a plate), Gómez de Cervantes deemed the simplest was to "throw them on a mat in the sun" for four days.[9]

Cochineal dye bonds best with animal fibers such as silk, sheep's wool, or hair from camelids (alpacas, llamas, and vicuñas). It was rarely, if ever, used on cotton or other vegetal fibers, unless it was painted on the surface as a pigment. In Mexico cochineal red was used on rabbit hair, perhaps the only type of animal hair available for textiles prior to the introduction of Merino sheep by the Spanish in the early part of the sixteenth century. Though its design shows Spanish colonial influence, an extraordinary Mexican textile in the Cooper-Hewitt National Design Museum in New York (fig. 26) was made in the sixteenth or seventeenth century using traditional Aztec techniques and materials, including spun feathers and cochineal-dyed rabbit hair.

Mexican dyers also used cochineal to prepare feathers for the featherwork "paintings" that were considered one of the wonders of the New World. Bernadino de Sahagún described how the native artisans laid the cochineal-dyed feathers beneath the naturally colored ones that formed the design. An exquisite sixteenth-century Mexican triptych with the Institution of the Sacrament of the Lord's Supper (fig. 27) was made exactly that way, with luminescent natural-colored hummingbird and other feathers arranged over an underlayer of cochineal-dyed feathers

24, 25. Cultivating a *nopalera* (nopal cactus) using a *coa* (left); The enemies of cochineal (right). *Memorial de Don Gonçalo Gómez de Cervantes del modo de vivir que tienen los indos, y del beneficio de las minas de la plata, y de la cochinella./Relación de [lo] que toca la grana cochinilla* (Mexico, 1599), Anonymous Pictorial Manuscript, pp. 98 verso 1–2, 98 recto 3–4. European paper, 12 x 10 in. (30.5 x 25.4 cm). British Museum, London (Add. Ms. 13964 [Am2006,Drg.210]) that create the red "mortar" in the brickwork flooring on which the disciples Peter and Paul stand.

In the Andes of South America cochineal was called *magno* or *macnu* by the Quechua and Aymara speakers who populated the highland regions. (Ludovico Bertonio's *Vocabulario de la lengua Aymara* of 1612 defines *makhno* as an "herbal cake with which they dye wool red"; see fig. 28.) Cochineal was found in abundance in the region, particularly in the south central highlands. The Spanish military leaders and their chroniclers, among them Juan de Sámano, secretary to King Carlos I; Francisco de Xérez, who traveled with Francisco Pizarro as he marched along the coast of Peru and into the Andes; and Miguel de Estete, who accompanied Hernando Pizarro (Francisco's brother) to the legendary temple of Pachacamac, noted its presence as soon as they set foot in the region in the 1530s.[10]

26. Tapestry band with quatrefoil and crenellation designs (detail). Probably Mexico, 16th–17th century. Dyed rabbit hair (the red cochineal), cotton, goose feathers; 7 x 55 in. (17.8 x 139.7 cm). Cooper-Hewitt, National Design Museum, Smithsonian Institution, New York. Gift of John Pierpont Morgan, 1902 (1902-1-374-a)

27. Triptych with the Institution of the Sacrament of the Lord's Supper. Mexico, 16th century. Natural-colored and cochineal-dyed feathers, *amatl* paper(?), cotton, wood, adhesive; each wing 19 x 6¼ in. (48.3 x 15.9 cm), center panel 19 x 12½ in. (48.3 x 31.8 cm). The Metropolitan Museum of Art, Gift of Coudert Brothers, 1888 (88.3.1)

28. *Macnu* (cochineal) pressed into the traditional cakelike form described in sixteenth-century Spanish chronicles. Salasaca, Ecuador, 1988

Most of the ancient textiles that survive from the Americas come from South America. The tens of thousands of textiles preserved in the dry Peruvian coastal desert offer a glimpse of some of the earliest periods of civilization on the continent and of the technical expertise and artistry of Andean weavers. Textile remains from the archaeological site of Carhua, on the south coast of Peru, provide evidence of the Chavín culture, which was based in the north central highlands but by 1000 B.C. had spread over great distances. The designs drawn on cotton fabric with black and red ochers and iron pigments (see fig. 4) echo the elaborate program of religious iconography, including composite supernatural fanged deities with caiman and avian features, carved on the Chavín stone monuments found thousands of miles to the north.

By 500 B.C. the people that lived in the Ica Valley, an area with water from snowmelt from the high Andes channeled through the rivers to the coast, had devised elaborate burial customs that included wrapping the honored dead in layer upon layer of cloth covered with designs of oculate beings with rayed heads and many appendages. Some of these cloths were profoundly and monochromatically red (see fig. 29). The complex woven designs of these red cloths embodied the spirit of the mythological landscape of early Peru. Their orange-red hue came from a dye that occurs in the fine hairlike roots of a shrublike plant of the genus *Relbunium* in the madder family (Rubiaceae).[11] Dyers of the region perfected the shades to include a deep rusty blood red.

Hundreds of mummies wrapped in layers of cloth were discovered slightly to the north of the Ica Valley in several monumental burial sites in the Paracas Peninsula that juts out into the Pacific Ocean. These elaborate burials, most of which date from about the second century B.C. to the second century A.D., are all that remain of the rich and complex culture of the Paracas people, who seem to have flourished from about 700 B.C. to A.D. 200. The textiles in the bundles

29. Mantle. Peru, Ocucaje, 2nd–1st century B.C. Sprang (intertwined) camelid hair, the deep red achieved with dyes from Peruvian plants of the genus *Relbunium*; 54¼ x 74⅜ in. (137.8 x 188.9 cm). The Metropolitan Museum of Art, Gift of Rosetta and Louis Slavitz, 1986 (1986.488.1)

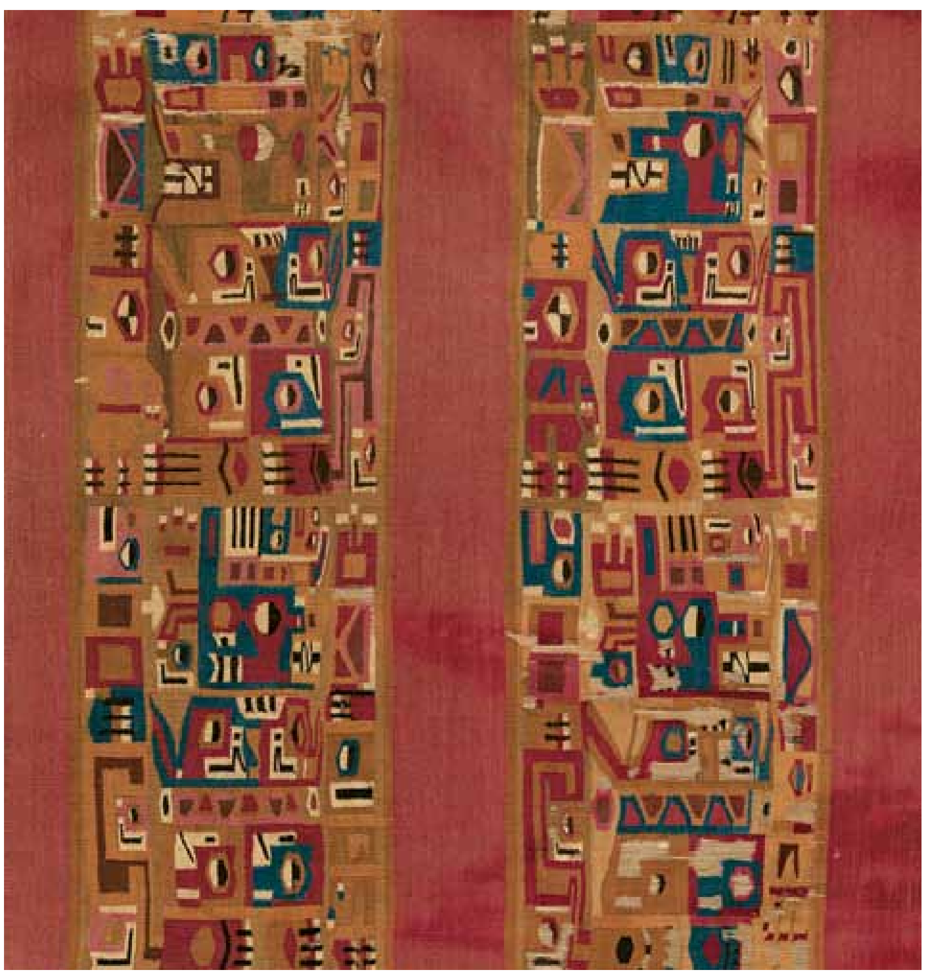
30. Border fragment (detail). Peru, Paracas, 1st century B.C.–2nd century A.D. Camelid-hair embroidery on cotton, the fluorescent red achieved with *Relbunium* dye; 43½ x 6¾ in. (110.5 x 17.2 cm). The Metropolitan Museum of Art, Gift of George D. Pratt, 1933 (33.149.87)

31. Textile fragment with faces and birds (detail). Peru, Recuay, 4th–6th century. Tapestry-weave camelid hair, the red and pink dyed with cochineal; 32½ x 13 in. (82.6 x 33 cm). The Metropolitan Museum of Art, Gift of George D. Pratt, 1930 (30.16.7)

of cloth used to wrap the dead in the Paracas sites were garments and sets of garments covered with minutely and meticulously embroidered composite animal-human creatures with many appendages wearing clearly articulated clothing and headdresses—among the most elaborate design programs developed anywhere in the Western Hemisphere (see fig. 30). Although the designs incorporated an unprecedented range of colors—fluorescent blues, deep greens, bright yellows—they were all for the most part red, albeit a red that was less orange and more a purplish crimson. Whether the shift to a clearer, bluer red was intentional or simply the incidental result of the mineral content of local water sources cannot be determined. Nearly all the brilliant scarlet colors of the

32. Coca bag. Peru, Moche, 5th–6th century. Tapestry-weave cotton and camelid hair, the red dyed with cochineal; 5 x 6 in. (12.7 x 15.2 cm). The Metropolitan Museum of Art, Bequest of Arthur M. Bullowa, 1993 (1994.35.88)

33. Tunic. Peru, Moche-Wari, 7th–9th century. Cotton and camelid hair colored with cochineal red and other dyes, in interlocking warps and wefts, with tapestry and openwork border; 34¼ x 58 in. (87 x 147.3 cm). The Metropolitan Museum of Art, Bequest of Jane Costello Goldberg, from the Collection of Arnold I. Goldberg, 1986 (1987.394.706)



34. Tunic fragment (detail). Peru, Wari, 7th–9th century. Tapestry-weave cotton and cochineal-dyed camelid hair, 22½ x 80 in. (57.2 x 203.2 cm). The Metropolitan Museum of Art, Gift of George D. Pratt, 1930 (30.16.1)

textiles from the Paracas necropolis were created with dyes from *Relbunium*, or plant red, but scientific testing has detected cochineal in a few examples—the earliest known instances of the use of the dye in Peru.[12]

The iconographic language of the Paracas embroideries recurs in the textiles and ceramics of the Nasca culture based in the valley of the Rio Grande de Nazca, some sixty miles south of Paracas, from about the first century A.D. until the eighth. The Nasca erected large pyramidal structures at Cahuachi, a ceremonial site and pilgrimage center, and they are known for the Nasca lines, huge geoglyphs (created by removing red rocks to reveal the paler ground beneath) forming geometric and animal shapes that traverse the desert floor. The Nasca built elaborate underground irrigation systems, now called *puquios*, that made agriculture possible. Cactus's ability to bear water-filled fruit had significance to a culture dependent on hard-won subsistence in the dry desert climate. (The illustrations on Nasca pottery also confirm that certain types of cacti were valued for their hallucinogenic and psychotropic properties.) Climate changes in the region in this period may have favored the growth of cactus, and the Nasca population also moved upriver to a habitat more favorable to the plants.[13] At what stage in history the primary focus shifted from the fruit of the cactus to the wild parasitic cochineal insect that destroys its host is not clear. But it was in the florescence of the Nasca culture that mastery of the production of red color from cochineal began on the south coast of Peru.

As soon as cochineal red appeared in the Americas, it eclipsed all other sources for the production of red-colored textiles. Easy to use and containing an abundance of colorant, cochineal quickly spread throughout the region. Some of the early examples of cochineal-dyed ritual cloths have been found in the central highlands in the Ancash region of northern Peru. Among them is a fragment of a camelid-hair textile in the Metropolitan's collection (fig. 31) that was produced by the Recuay people, who were contemporaries of the Nasca.

Cochineal red found its way to the north coast of Peru early in the history of the sophisticated Moche civilization that held sway in the valleys along Peru's northern coast from about the first to the ninth century. A tapestry-woven coca bag with a large winged and masked figure on either side that dates to the fifth or sixth century (fig. 32) may be the earliest example of a cochineal-dyed textile from the region. A tunic from the seventh to ninth century with a bold repeat design of cochineal red animal heads, probably camelids (fig. 33), represents artisanry that may have originated in the foothills of the Andes, where coastal cultures interchanged goods and ideas with the people of the mountain regions, in this case the Wari. The Wari, who were centered in the south central highlands, expanded their sphere of influence beginning in the fifth century and continued to impact on Andean cultures to the north and south into the tenth century. Artisans working under the auspices of the Wari

35. Tunic. Peru, Chimú, 12th–15th century. Tapestry-weave cotton and cochineal-dyed camelid hair, 23⅝ x 30¼ in. (72.7 x 76.8 cm). The Metropolitan Museum of Art, The Michael C. Rockefeller Memorial Collection, Bequest of Nelson A. Rockefeller, 1979 (1979.206.588)

36. Tassel from an Inca bag with designs of llamas. Peru, Inca, 15th–16th century. Cotton and camelid hair, 15¾ x 8 in. (40 x 20.3 cm). The Metropolitan Museum of Art, Rogers Fund, 1928 (28.171.4). The fringe, reminiscent of the royal Inca headgear called the *mascaypacha*, was dyed with cochineal, with yellow colorant added to the dyebath to produce the blood red color.

administration created sophisticated tapestry-woven tunics from finely spun camelid-hair yarn dyed a number of colors. By about 600–800, when the fragment in the Metropolitan (fig. 34) was woven, cochineal dye was readily available in the Andes and was used to create most of the resplendent reds in these extraordinary garments, which represented the state of the art in both design and technique.

The early Peruvian weavers consistently pushed the edges of artistic mastery, and subsequent cultures, too, developed evocative and technically challenging methods to create complex and beautiful textiles. From the twelfth to the fifteenth century, the Chimú people of the central coast designed elaborate garments using an abundance of cochineal red. A tapestry-woven tunic decorated with abstract felines alternating with figures in crescent headdresses (fig. 35) evinces the strong visual character of the designs of the Chimú artisans.

The Inca, whose empire extended from northern Ecuador to southern Chile from the 1430s until 1532, associated red with the ancient and mythical origins of religion and culture. Mamahuaco, the first Inca queen and the female primogenitor who along with her husband and one other couple was responsible for populating the earth, is said to have emerged from the Cave of Origin (Pacaritambo) wearing a red dress (see fig. 37).[14] For the Inca, red was also a symbol of

37–39. Left to right: *Coya Mamahuaco*; *Mango Capac, primero*; *Capac Yupanqui*. Martín de Murúa (Spanish, ca. 1525/35–1618), *Historia general del Perú* (Southern Andes, 1590–1613), fols. 23r, 21v, 30v. Handmade rag paper with pigments and ink, 12 x 8 in. (30.5 x 20.3 cm). J. Paul Getty Museum, Los Angeles (83MP159 [former MS Ludwig XIII])

40. Tunic. Peru, Inca, 15th–early 16th century. Cotton and camelid hair, 35 x 29 in. (88.9 x 73.7 cm). The Metropolitan Museum of Art, Rogers Fund, 1982 (1982.365). The red part of the waistband was dyed with cochineal.

42. *Túpac Amaru I*. Peru, ca. 1850–70. Oil on canvas, 32⅝ x 22 in. (83 x 56 cm). Museo Nacional de Arqueología, Antropología e Historia del Perú, Lima

royalty and nobility, and it played a key role in both diplomacy and empire building. Only the king could wear the red *mascaypacha*, or royal fringe (see figs. 36, 38, 42), on his forehead. Some of the official garments worn by the royal Inca army and woven by special royal weavers, the *cumbicamayos*, had bright crimson V-shaped yokes juxtaposed with the checkerboard design that formed the body of the tunics; others had red waistbands with bands of symbolic images or concentric diamond patterns (see figs. 38–40).[15] According to native Peruvian Felipe Guaman Poma de Ayala, whose 1,200-page *El primer nueva corónica y*

41. Tunic. Chile, Arica(?), 15th–early 16th century(?). Camelid hair and feathers, the red and purple dyed with cochineal; 35¼ x 54½ in. (89.5 x 138.4 cm). The Metropolitan Museum of Art, Gift of John B. Elliott through the Mercer Trust, 2000 (2000.160.25)

buen gobierno (The First New Chronicle and Good Government) of 1615–16 is one of the few surviving illustrated manuscripts chronicling Peru's history before and after the arrival of the Spanish, Inca red was described by several terms, including earth red and blood red.[16] The red color in the concentric diamond waistband of a royal Inca tunic in the Museum's collection (fig. 40) is dyed with cochineal and an unknown yellow colorant that was intentionally used to alter the hue from the naturally pinkish red to a deeper, blood red color.

In the realm of Inca ritual and religious worship, red garments were signals to the gods. During the Inca ritual of *capacocha* young women dressed in red and white garments were sacrificed to Ilyapa, the lightning god who lived on the high mountaintops. Juan de Betanzos, who based his *Narrative of the Incas* of 1557 in part on the testimony of his wife, the former spouse of the Inca king Atahualpa, reported that during the great festival of the sun, "all the lords of Cuzco dressed in long red tunics that come down to their feet."[17] The long red tunics symbolized the power and authority of the native lords and linked them to the ancient history and custom of their primogenitors and the process of creation. The use of these ritual red tunics extended, along with the borders of the Inca Empire, to the far south coast of Peru and northern Chile (see fig. 41).

The Inca Empire was defeated the moment the Inca king, Atahualpa, was killed by Spanish soldiers in 1533. Forty years later, in 1572, the execution of Túpac Amaru I, the last of the Inca royal family with legitimate claims to sovereignty (fig. 42), took place in the central plaza of Cuzco. Captain Baltasar de

43. Woman's wedding mantle. Peru, late 16th–early 17th century. Tapestry-weave cotton and camelid hair colored with cochineal and other dyes, 45½ x 49⅝ in. (115.6 x 126.1 cm). The Metropolitan Museum of Art, Rogers Fund, 1908 (08.108.10)

44. Hanging or cover with figurative scenes. Peru, 17th century. Tapestry-weave cotton and camelid hair colored with cochineal and other dyes, 89⅝ x 84¾ in. (227.5 x 215.3 cm). The Metropolitan Museum of Art, Purchase, Morris Loeb Bequest, 1956 (56.163)

Ocampo, a Spanish soldier who witnessed the event, wrote a vivid and moving account. "The open spaces, roofs, and windows in the parishes of Carmenca and San Cristóval," he reported, "were so crowded with spectators that if an orange had been thrown down it could not have reached the ground anywhere, so closely were the people packed. The executioner, who was a Cañari Indian, having brought out the knife with which he was to behead Tupac Amaru, a marvellous thing happened. The whole crowd of natives raised such a cry of grief that it seemed as if the day of judgment had come, and all those of Spanish race did not fail to show their feelings by shedding tears of grief and pain." Túpac Amaru had been marched into the city in chains, dressed in a "mantle and doublet of crimson velvet. His shoes were made of wool of the country, of several colours. The crown or headdress, called *mascapaychu*, was on his head, with fringe over his forehead, this being the royal insignia of the Inca."[18] He may have been wearing the luxurious dress of the conquerors who were about to convert him to Christianity and baptize him Felipe after the Spanish king, but his velvet garments were nevertheless colored the royal Inca red, the same red as his royal fringe.

After the arrival of the Spanish, Andean artisans continued to create textiles of great beauty and sophistication, albeit now often incorporating both Inca and European aesthetics, for both native and Spanish clients. Cochineal was used to create the red Spanish fretwork design on a mantle that dates to the late sixteenth or early seventeenth century (fig. 43). And an abundance of cochineal red forms the field of a tapestry with a lively design incorporating scenes from classical mythology (fig. 44).

The crimson velvet worn by the last Inca king was probably also dyed with cochineal, but it had no doubt come from Europe, brought to Peru by Spanish traders. The Spanish Crown had decreed that luxury cloth such as silk and velvet could not be produced in the Americas but must be brought from Spain. The production of this luxurious and deeply dyed red silk velvet, along with the privilege of wearing it, was regulated by law in Spain as well. In fact, sumptuary laws of the period throughout Europe dictated what could and could not be worn, including the color and type of cloth. The quality and color of the cloth one wore indicated one's status and identity.

For centuries the color purple had carried royal connotations; it was the distinguishing color of the robes of Roman emperors, European monarchs, and the cardinals of the Roman Catholic Church. By the end of the fifteenth century, however, on the eve of the discovery of the Americas, the famous shellfish purple dyeworks of antiquity had all but disappeared, due to overproduction and the near extinction of the animal resource. In 1464 Pope Paul II finally officially changed "Cardinal's Purple" to red, which could be produced from insects rather than shellfish. Throughout Italy, red had long been an expensive and regulated color. Only certain privileged people—the *coccinante*—were allowed to wear red.[19] Who could wear or purchase particular types of silks and luxury cloth was also prescribed by decree. In 1558, for example, women of the city of Pistoia were not allowed to wear cloth from Lucca or cloth made of *grana* (insect red), and married women in Florence were not to wear red.[20] By that time, the source of the crimson color so prized for luxury cloth would have been cochineal from the Americas, which had slowly been replacing the kermes or *grana* from Spain and Sicily and the Armenian or Polish insects (sometimes referred to as *carmesi*) that Venetian traders had brought from the east.

In 1523 the Spanish sovereign, Carlos I, ordered Hernán Cortés to inform him at once whether and how much kermes (the Spaniards at first incorrectly believed the American insects to be identical to the

45. Directions of world trade in American cochineal

46. Design attributed to Giovanni Battista Lodi da Cremona (Italian, flourished 1540–1522), woven in the workshop of Willem de Pannemaker (Flemish, flourished 1535–78), Brussels. *The Bridal Chamber of Herse*, ca. 1550. From a set of eight tapestries depicting the story of Mercury and Herse. Wool, silk, silver, silver-gilt thread; 14 ft. 5 in. x 17 ft. 8 in. (4.4 x 5.4 m). The Metropolitan Museum of Art, Bequest of George Blumenthal, 1941 (41.190.135). Cochineal (American or Armenian) was found in the red dye in the border.

European *grana*) had been found in New Spain and to "cause as much as possible to be collected with diligence."[21] And by the mid-sixteenth century the Spanish flotillas that traveled annually between the Americas and Spain were bringing literally tons of the dried insects to Europe. According to Jose de Acosta, a Spanish naturalist who recorded the flora and fauna of Peru, the shipments from Lima to Spain in 1587 included 5,677 *arrobas* (about 144,000 pounds, or 72 tons) of cochineal. Cochineal, along with gold and silver from the Americas, enabled the Spanish Crown to finance its empire, including the 1535 invasion of Tunis to fight the Turkish army of Süleyman the Great, while establishing its global monopoly and dominance of sea trade.

Shipments of cochineal landed in Seville and later in Cádiz, until the eighteenth century the only ports that Spanish law allowed to receive them, as part of Spain's efforts to control its monopoly on trade with the Americas (see map, fig. 45). Once received at the Spanish ports, shiploads of cochineal were traded to the north, where the colorant was used in the thriving tapestry production of the Netherlands and France. To the east it colored the famous Venetian red velvets and silks that were traded throughout the world. An international set of merchants based in Spain played a major role in the distribution of American goods to the Middle East to supply the Ottoman Empire. Cochineal from the Americas was shipped in the Manila galleons, the huge Spanish carrack ships with enormous hulls that traveled between Mexico and the Philippines, and then along sea routes to China and via ancient overland silk routes to the Middle East. In the great period of international cultural exchange from the sixteenth to the eighteenth century, cochineal was used in works of art in areas as far flung as the remote mountainous regions of Uzbekistan and the Indonesian archipelago.

47. Suit. England, 1750–75. Cochineal-dyed wool with silk and gold. The Metropolitan Museum of Art, Isabel Shults Fund, 1986 (1986.30.4a–d). The densely felted cochineal-dyed wool of this suit is typical of English woolens, including that used for the uniforms of the British redcoats.

Amsterdam was a major trading hub for the Spanish dye, the Dutch serving both as distributors of cochineal as it was re-exported to Italy and France and as experts in its use. Antwerp also played an important role in the cochineal trade. The historian Francesco Guicciardini, who died in 1540, already mentioned cochineal as one of the articles imported from Spain by Antwerp.[22] Flemish dyers became renowned for their early expertise in cochineal dyeing. Pieter Coecke van Aelst, a master painter of tapestry cartoons, is known to have experimented with cochineal dyeing shortly after it became available in the region.[23] One of the earliest surviving examples of Flemish tapestry in which American cochineal has been identified through scientific analysis is a coat of arms woven in Bruges in 1550 by Aernout Van Loo for the De Nagera, a family of Basque Spanish origins.[24] Cochineal has also been identified in the Metropolitan's *Bridal Chamber of Herse* (fig. 46), a tapestry from the workshop of Willem de Pannemaker, who worked in Brussels between 1535 and 1578.

The English, early consumers of cochineal red dye for their woolen industry, in the seventeenth century relied in part on skilled Dutch dyers to produce the desired red color, and fine English woolen cloth was shipped to the Netherlands to be dyed. By 1625 the Dutch dominated scarlet dyeing, and 50,000 people in the Netherlands were employed in dyeing English

48. Textile fragment with confronted crowned lions. Spain, Nasrid period, 15th century. Lampas-weave silk colored with kermes and other dyes, 10¼ x 14⅝ in. (26 x 37.1 cm). The Metropolitan Museum of Art, Gift of Clara Waldeck, in memory of her husband, Hans Waldeck, 1981 (1981.372)

woolens.[25] The well-made red woolen coats that were the signature uniforms of the British army (see fig. 47) were dyed with cochineal beginning in this period and on into the late nineteenth century.

At the time of the discovery of the Americas in the early sixteenth century, the textile industries of Spain and Italy were among the most important commercial enterprises in Europe. Silk weaving workshops, called *tiraz*, had been established under Arab rule in Spain in the eighth century, by Islamic rulers who brought with them knowledge of silkworm cultivation and the complex drawloom weaving developed in the Middle East. Silk production, dyeing, and weaving thrived in Al-Andalus, the Muslim-ruled region of what is now Spain, particularly in Granada and Alpujarra, where mulberry trees could be cultivated to sustain the silkworms. Silk weaving centers prospered as well in Cordova, Valencia, and Seville. The natural resources available for producing strong, fast brilliant red from dyestuffs indigenous to the region included the native kermes (see fig. 48), which was used to dye most of the red silk produced for the nobility, and the plant dye madder.

During periods of interchange with the east, some of the other insect red dyes, including Polish and Armenian cochineal and lac, were imported to Spain; they can all be found in Spanish silk textiles made prior to the discovery of the Americas. Soon after the first imports of cochineal began to arrive from Mexico and Peru, the dyestuff became ubiquitous in Spain. The bright red colorant on a Hispano-Moresque curtain panel fragment in the Metropolitan (fig. 49) was made with a cochineal insect, but scientific analysis could not determine whether the insects were from Armenia or from America. If it was the American

49. Fragment of a curtain panel. Spain, 15th century. Lampas-weave silk colored with cochineal (Armenian or American) and other dyes, 23⅝ x 23⅝ in. (60 x 60 cm). The Metropolitan Museum of Art, Rogers Fund, 1912 (12.55.6a)

50. Cope. Spain, 16th century. Compound satin weave silk, the red dyed with cochineal and tannin, with band of embroidery in silk, linen, and metal thread; 53 x 113 in. (134.6 x 287 cm). The Metropolitan Museum of Art, Rogers Fund, 1951 (51.139.7)

51. Banner with King David and the coat of arms of the Order of Our Lady of Mercy. Spain, inscribed 1596. Silk and metal thread, 50 x 90 in. (127 x 228.6 cm). The Metropolitan Museum of Art, Gift of Melvin Gutman, 1958, (58.172). Cochineal dye was used in the embroidered cartouche.

52. Textile fragment. Spain, 17th century. Compound satin weave silk, the red dyed with cochineal; 17½ x 23 in. (44.5 x 58.4 cm). The Metropolitan Museum of Art, Anonymous Gift, 1879 (79.1.26)

type, then the textile could not have been made before the 1520s, when Spain encountered Mexico and began to import the native insect dye. The cochineal dye that forms the woven pattern on a sixteenth-century silk cope from Spain (fig. 50) no doubt came from the Americas, as did the cochineal red in the embroidered appliquéd cartouche on a Spanish banner inscribed 1596 (fig. 51) and a striking seventeenth-century Spanish silk (fig. 52) that was one of the Museum's earliest acquisitions. Flocking of wool almost certainly dyed with American cochineal forms the ground in the design on an extraordinary leather and gilt chasuble made in Spain in the late sixteenth or early seventeenth century (fig. 53).

The special expertise of Italian silk weavers fostered a prosperous industry beginning in the twelfth century. Weavers in the northern towns of Lucca, Florence, and Venice imported silk yarns from Spain and Sicily, where the silkworms were raised locally, as well as from Constantinople and beyond. Silk textile production was carefully overseen by the Italian guilds, which strictly defined the methods of production and monitored quality control. As the industry grew, the ability to produce the same color consistently on long lengths of cloth was essential, and the art and craft of dyeing also became strongly regulated. A number of processes for dyeing red cloth are described in the detailed instructions for silk manufacturers set out in the *Trattato dell'Arte della Seta* (see fig. 54), a fifteenth-century manual from the Arte della Seta, or Silk Guild, of Florence. (Nine copies of the manuscript, all apparently copied from a lost original, survive; the earliest dates from 1453.)[26] The first printed book on dyeing, published in Venice in 1548, was Giovanventura Rosetti's *Plictho de l'arte de tentori* (Instructions in the Art of the Dyers). While Rosetti included many recipes for red colors, none specified the use of American cochineal. The recipes do, however, refer to a number of types of kermes. According to Rosetti, Venetian reds had traditionally been achieved with plant madder or kermes, either of Mediterranean origin (insects he called *grana*) or from eastern Europe (*cremesi*), or even with a mixture of madder and kermes.[27]

53. Chasuble. Spain, late 16th or early 17th century. Leather, wool, silver and gold leaf; 40½ x 25 in. (102.9 x 63.5 cm). The Metropolitan Museum of Art, Frederick C. Hewitt Fund, 1914 (14.134.19). Flocking of cochineal-dyed wool, perhaps shredded from used cloth to create loose fibers, was adhered to the leather surface.

54. A weaver seated at a loom weaving red cloth. *Trattato dell'Arte della Seta* (Florence, 15th century), fol. 37r. Biblioteca Medicea Laurenziana, Florence (MS Plut.89 sup.117)

55. Velvet fragment. Italy, 16th century. Cut silk velvet with silver thread in green selvage (see detail), 14 x 10½ in. (35.6 x 26.7 cm). The Metropolitan Museum of Art, Gift of Nanette B. Kelekian, in honor of Olga Raggio, 2002 (2002.494.469). The red is cochineal, probably American rather than Armenian.

The weaving of velvet cloth was a specialized skill that required expert craftsmen and additional mechanical features on the loom. The aim was to create a deep pile whose color was accentuated by the plush surface. In the sixteenth and seventeenth centuries Venetian and other Italian velvet weavers mastered the art of patterning the velvet by creating different levels of pile, producing the designs in relief, or adding metallic threads to enhance the patterns. Deep tones of densely colored velvets—reds prominent among them—were the pride of the country, and dyers' secrets for creating these colors were maintained within families, guilds, and towns. The secrets of the trade were protected by law, and skilled dyers were forbidden to move from one town to the next.

In the early sixteenth century Italian guild regulations prohibited the use of cochineal from the Americas, but by midcentury, after guild dyers had conducted experiments with the Mexican variety, it was beginning to be accepted for creating the famous Venetian red velvets.[28] Its use was strictly controlled. Red color for silk velvet could be made from the various insect dye sources, which while close in hue and difficult to differentiate, varied greatly in cost depending on where they had been imported from. As the cost of the cloth was affected by the dyestuff used to create it, regulations were put in place to ensure that the sellers of fabrics correctly represented the type of dye they had used. One way to do that was to mark the selvages of the woven cloth. In the mid-fifteenth century, when mixtures of red dyes were banned, a green selvage with a single gold thread down its center certified that a fabric had truly been dyed with kermes alone. When the use of cochineal imported from the Americas was sanctioned in the mid-sixteenth century, a silver thread in a green selvage on velvet, damask, or satin indicated that it had been dyed with "foreign" (i.e., American) cochineal red.[29] Scientific analysis confirms that the red dye in a sixteenth-century Italian

56. Designed by Alessandro Allori (Italian, 1535–1607); woven in the workshop of Guasparri di Bartolomeo Papini, Florence. *The Gathering of Manna*, 1595–96. From a set of three tapestries depicting Old Testament prefigurations of the Eucharist and Passion of Christ. Wool and silk colored with cochineal and other dyes, 14 ft. x 14 ft. 8 in. (4.3 x 4.5 m). The Metropolitan Museum of Art, Purchase, The Isak and Rose Weinman Foundation Inc. Gift and Rogers Fund, 2004 (2004.165)

velvet in the Metropolitan Museum that has a green selvage with a single silver thread (fig. 55) is likely to be the American-type cochineal.

The cochineal dye from the Americas that was used in Italy beginning in the 1600s would have come via Cádiz, the port of Spain whose monopoly on the special dyestuff lasted throughout the century. Members of the Medici family were involved in the importation of goods from Spain into Italy for a number of their enterprises. They arranged for shipments of cochineal from Cádiz to Livorno, on the western coast of Italy. In September 1566 Tommaso di Iacopo de' Medici wrote to Vincenzo Ambrogi on behalf of Grand Duke Cosimo I de' Medici that not all the goods he had sent from Spain "have been sold with a profit in Florence. In particular, there is little demand for *cucinilia*." By February 1571, however, Tommaso was complaining to Ambrogi that although he had repeatedly requested it, the ship recently arrived from Spain had brought no cochineal. Along with cochineal, the Medici were importing American sugar, olives, pearls, and other dyestuffs such as brazilwood.[30] Velvet drapes dyed carmine red in Spain were ordered to furnish the house of Livia Vernazza, the mistress and later the wife of the grand duke's son Giovanni.

A Florentine workshop used cochineal dye to create the rich red accents in a tapestry in the Metropolitan (fig. 56) that was one of a set of three that Ferdinand de' Medici presented to Alessandro de' Medici, archbishop of Florence (and later Pope Leo XI), as he set off for France as papal ambassador in 1596. A member of another powerful Italian family, Cardinal Antonio Barberini, was the recipient of a magnificent cope (fig. 57) that was also dyed with American cochineal.

Since the Middle Ages, long-standing traditions of European dyers had recognized that certain dyes held their color while others faded in sunlight or changed hues over time. In France, good strong dyes that kept their color and were fast to sunlight and water were referred to as *bons teints*. These included madder, insect reds (kermes and cochineal), and indigo. The so-called false dyes were brazilwood, annatto, and others that would change color or disappear altogether over time. The dyes used in the royal tapestry workshops under the patronage of Louis XIV were codified by Jean-Baptiste Colbert, Louis's famed minister of finance. In 1662, on the king's behalf, Colbert purchased the centuries-old dyeworks of the Gobelins family on the banks of the Bièvre River in Paris and proceeded to transform it into a tapestry and upholstery manufactory. He brought in a master Dutch dyer, Josse van den Kerchove, to formalize the dyeing processes at the factory.[31] Colbert and one M. d'Albo have been credited with the authorship of an anonymous dyebook published in Paris in 1671 titled *Instruction générale pour la teinture de laines et manufactures de laine de toutes couleurs* (General Instructions for the Dyeing of Wool and Manufacture of Wool of All Colors). Their manual lists seven types of *bons teints* for red: French Red Scarlet (or Gobelins Red Scarlet or *graine* scarlet, referring to kermes), Cramoisy Red (crimson), madder red, half-*graine*, half-Cramoisy,

57. Cope. Italy, 1623–28. Compound weave silk colored with cochineal and other dyes, metal thread; 52½ x 119 in. (133.4 x 302.3 cm). The Metropolitan Museum of Art, Gift of Walter Jennings, 1911 (11.101). The woven design incorporates the device of the Barberini family, a bee and the sun in splendor, and the orphrey is embroidered with the arms of Cardinal Antonio Barberini, encircled by the Order of Saint John of Jerusalem, or Malta, and superimposed on a silver Maltese cross.

58. The Croome Court Tapestry Room. Paris, 1758–67. General conception designed by Jacques-Germain Soufflot (1713–1780); pictorial medallions designed by François Boucher (1703–1770); decorative surrounds (*alentours*) and some furniture covers designed by Maurice Jacques (1712–1784); other furniture covers designed by Louis Tessier (1719/20–1781); woven in the *basse-lisse* workshop of Jacques Neilson (1714–1788) at the Gobelins Manufactory, Paris, 1764–71. Tapestries of wool and silk colored with cochineal and other dyes. The Metropolitan Museum of Art, Gift of Samuel H. Kress Foundation, 1958 (58.75.3)

nacarat de bourre (flock or shred red), and cochineal scarlet, "as made in Holland." (Dutch scarlet, as it came to be called, was developed after English and Dutch chemists, among them Cornelius Drebbel, found that the addition of tin as a mordant created a brilliant orange-hued red.) A century later the Manufacture des Gobelins used cochineal red to create the crimson and dark pink ground of a magnificent set of tapestries and seat covers for a room that the Earl of Coventry hired architect Robert Adam to design for him at Croome Court, the earl's Palladian-style mansion in Worcestershire, England. The room and its furnishings have been reinstalled in the Metropolitan Museum (fig. 58).

The period from the late 1700s to the late 1800s was a time of great experimentation that fostered the growth of science and the observation and discovery of the nature of materials and elements and their behavior. Manuals and treatises published in those

59. Fragment of brocaded silk. Italy, late 17th–early 18th century. Silk colored with cochineal and other dyes, metal thread; 17¾ x 10¾ in. (45.1 x 27.3 cm). The Metropolitan Museum of Art, Rogers Fund, 1909 (09.50.1117)

60. Rembrandt van Rijn (Dutch, 1606–1669). *Aristotle with a Bust of Homer*, 1653. Oil on canvas, 56½ x 53¾ in. (143.5 x 136.5 cm). The Metropolitan Museum of Art, Purchase, special contributions and funds given or bequeathed by friends of the Museum, 1961 (61.198). Cochineal lake pigment was identified in the black shadows.

61. Vincent van Gogh (Dutch, 1853–1890). *Shoes*, 1888. Oil on canvas, 18 x 21¾ in. (45.7 x 55.2 cm). The Metropolitan Museum of Art, Purchase, The Annenberg Foundation Gift, 1992 (1992.374). Cochineal lake pigment was found in the shadow on the inside of the right shoe and on the flooring.

years document the increasing expertise of dyers, who were able to create strong, even, fast colors and to repeat their creations in a consistent way. Jean Hellot, whose 1789 *Art of Dying Wool, Silk, and Cotton* continued Colbert and D'Albo's work, described "fire scarlet" or Dutch scarlet as "tinged with orange, . . . fiery red and dazzling. . . . Cochineal, which produced this beautiful color, and which is called Mestique or Texcale [after the regions of Mexico where it was cultivated], is an insect gathered in considerable quantity in Mexico." Apart from the high-quality cultivated Mexican cochineal and its lower-quality cousin, wild cochineal (which the Spanish called *grana silvestre*), according to Hellot a third type of cochineal was available on the market, at a lower price: "damaged cochineal" that was "sometimes sold at Cádiz, either shipwrecked or by some mischance, wet with sea water." Hellot also discussed the choice of water for dyeing fabrics scarlet, noting that "common water," containing stony or calcareous earth that makes it hard, "saddens the color."[32]

62. Needlework picture. Boston, ca. 1750. Wool and silk embroidery on linen, the pink dress embroidered with cochineal-dyed wool; 10¾ x 13¾ in. (27.3 x 34.9 cm). The Metropolitan Museum of Art, Gift of Mrs. Screven Lorillard, 1953 (53.179.13)

By the eighteenth century cochineal was being used in Europe for two colors: crimson, a deep, purplish red, and scarlet, the brilliant orange red. Crimson (see fig. 59) was produced with a number of recipes that enhanced the natural bluish qualities of the cochineal pink, while scarlet (see fig. 64) was made, after the Dutch method, by adding tin salts and other chemicals to the dyebath. To further enhance the brilliant scarlet color, some recipes of the period call for the addition of a yellow dye, such as turmeric, a tropical rhizome imported from Southeast Asia. Once trade began with the Americas, an abundant and less expensive alternative was available: annatto seed paste, which was imported in large quantities and incorporated into dye recipes to help create the appropriate hue for cochineal scarlet.

While cochineal was valued primarily for its dyeing properties, from the sixteenth until the late nineteenth century painters and sculptors in Europe also relied on lake pigment prepared with cochineal extract to

63. Mary Breed (American, 1751–ca. 1784). Coverlet pieced together from a set of bed hangings. Stonington, Connecticut, 1770. Wool embroidery, the pink dyed with cochineal, on linen and cotton; 90¾ x 89 in. (230.5 x 226.1 cm). The Metropolitan Museum of Art, Rogers Fund, 1922 (22.55)

64. Calamanco quilt. New England, ca. 1775–1800. Stitched and quilted wool, the red dyed with cochineal with tin mordant; 87 x 92 in. (221 x 233.7 cm). The Metropolitan Museum of Art, Purchase, Gift of Joan G. Hancock, in memory of Frances Burrall Henry, by exchange, 1998 (1998.105)

attain certain shades of red. Mineral pigments were used for the bright red colors, but subtle shading with cochineal lakes enhanced a picture's depth and hue. Cochineal has been found, for example, forming the complex and rich depths of the shadows in Rembrandt's *Aristotle with a Bust of Homer* (fig. 60) and in the lively reds of Van Gogh's *Shoes* (fig. 61).

In the eighteenth century cochineal red made its way to the English colonies in North America. The pink dress of the Indian princess in a needlework picture made in Boston about 1750 (fig. 62) was embroidered with cochineal-dyed wool, and Stonington, Connecticut, resident Mary Breed used pink woolen embroidery yarns dyed with cochineal for the set of bed hangings she created in 1770 (fig. 63). The center panel of a pieced quilt attributed to New England and dated to the last quarter of the eighteenth century (fig. 64) is made of a glazed wool fabric called calamanco that was dyed with cochineal mordanted with tin to make the brilliant orange-red hue popularly called fire scarlet.

Prior to the American Revolution, dyers in North America received their cochineal not directly from their Mexican neighbors, the primary suppliers to the world at large, but rather from England, as trade was rigorously controlled in the colonies. Spanish ships brought dried cochineal from Mexico to Cádiz in Spain, and from there it traveled to England. From England it crossed the Atlantic once again, back to the coastal colonies on the American continent. Asa Ellis, whose *Country Dyer's Assistant* of 1798 was one of several eighteenth-century American dyers' manuals that discussed the use of cochineal and listed the types of insects and how best to identify their quality and origin, complained that "cochineal is an insect cultivated in South America. It is shipped to Spain, from Spain to England, whence we obtain it at a high price on the account of accumulated and heavy duties."[33]

North American traders also salvaged cochineal from the wrecks of Spanish ships heading from the Mexican port of Veracruz to Cádiz that had fallen victim to hurricanes in the Gulf of Mexico. When the *Nuevo Constante* sank off the coast of Louisiana in 1766 on its way from Veracruz to Cádiz, for example, it was laden with more than 10,000 pounds of "powdered" and wild cochineal packed in leather bags (*zurrónes*) along with various other cargo, including more than 5,000 pounds of annatto and 2,000 of indigo. Even though salt water damaged the salvaged cochineal, it could still be sold at a good price, and without the heavy taxes.

The same New Spain fleets that brought cochineal from the Americas to Spain during the sixteenth,

65. Wearing blanket. Arizona, Navajo, 1860–70. Tapestry-weave wool, 67½ x 49 in. (171.5 x 124.5 cm). The Metropolitan Museum of Art, Gift of Mrs. Russell Sage, 1910 (10.107.1). The red 3-ply Saxony yarn was dyed with cochineal.

seventeenth, and eighteenth centuries returned with European goods on outbound journeys from Cádiz. Among the cargo were crimson and scarlet dyed European felted and fulled woolens called *bayeta* in Spanish and baize in English. As diplomatic gifts and items traded at posts and forts, the red fabrics traveled north from the port of Veracruz with missionaries and other travelers and via the U.S. Army to the American Southwest (until 1821 Mexican territory), where Native American weavers of the Navajo, Hopi, and Zuni tribes had developed complex textile traditions. Prior to the sixteenth century the colors of the clothing and blankets made in the region were rather subdued, and red, in particular, was rare. Local weavers had for millennia relied on plant fibers such as yucca and cotton, which could not be easily dyed. (Animal skins, another type of material used for certain special garments and ritual items, could on the other hand be decorated with color painted on their surface.)[34] After the Spanish brought the Old World breed of Churro sheep to the area in the mid-sixteenth century, sheep's wool entered the weavers' vocabulary and new color possibilities emerged, since the fiber could be dyed more intensely and with a greater range of dyestuffs, which eventually included cochineal.

Native American weavers were also able to incorporate brilliant reds into their textiles by utilizing dyed yarns that came via trade with Europeans. The native weavers also salvaged crimson and scarlet

66. Doña Rosa Solis y Menéndez. Coverlet (*colcha*). Mérida, Yucatán, Mexico, dated 1786. Silk embroidery, the red dyed with cochineal, on hand-woven cotton; 100 x 73 in. (254 x 185.4 cm). The Metropolitan Museum of Art, Purchase, Everfast Fabrics Inc. Gift, 1971 (1971.20)

imported *bayeta* fabric and patiently raveled its original yarn components, which then could be reused for weaving. *Bayeta* cloth was originally woven in various parts of Europe and England, but it was subsequently produced in some form in all the Spanish colonies, by the end of the sixteenth century aided by the introduction of Spanish treadle looms.

Although southern Mexico was one of the primary sources of cochineal insects, the dye does not seem to have been traded northward in Precolumbian times, perhaps due to the absence of the animal fibers that are best suited to its use. The Spanish may have brought some cochineal to the region, but it was not established into the dyeing tradition. In the seventeenth and eighteenth centuries the reds of the cloth imported from England, Spain, and the Netherlands were generally from insect dyes, which could be either cochineal or lac. The identification of the specific type of insect dye found in the yarns woven into Navajo blankets has become one indicator of when the blankets were made. Lac has been found in many blankets dated from the early nineteenth century to the 1860s, when cochineal-dyed fabrics began to predominate. Cochineal was used to dye the three-ply wool yarn that forms the striated red background in an exceptional Navajo blanket in the Museum that has been dated to 1860–70 (fig. 65).

The presence of lac dye in the red yarns used by Navajo weavers reflects the international character of trade at the time. The use of red dye produced from

67. Wedding banner. China, second half of 19th century. Silk, metallic thread, glass, and brass on silk ground dyed with cochineal; 126 x 57 in. (320 x 144.8 cm). The Metropolitan Museum of Art, Gift of Mr. and Mrs. George Weitzel, 1964 (64.227)

the lac insect was not part of Spanish textile tradition in either Europe or the colonies, as the dyestuff had to be imported from India or Southeast Asia, where Spain held no trade monopolies. That the cochineal-dyed red silk thread in the embroidered design on a coverlet whose inscription establishes its origin in the Yucatán in 1786 (fig. 66) may have come from China is further evidence of the globe-circling exchange of goods.

The Manila-Acapulco galleons brought treasures from the Americas to Asia via the Pacific sea routes beginning in 1564. The Spanish ships exchanged American silver and other goods, by the 1580s including cochineal, for Chinese silk, porcelain, and other exotica that they brought back to Mexico, where most but not all of it was transported overland and shipped back eastward to Spain. From Manila, cochineal entered the Chinese market primarily by way of Canton (Guangzhou). By the eighteenth century other European empires seeking their share of the profits were involved in trading the dried insects: in 1765 some thirty English, French, Dutch, Danish, and Swedish ships loaded cochineal at Canton that had been exported from Acapulco. By then cochineal also figured in the trade of Cambodia and Siam.[35] Although shipping manifests prove that American cochineal was sent to China before the 1700s, and archival references indicate that by about 1700 the Chinese Kangxi emperor knew of a dyestuff called *ko-tcha-ni-la*, the insect from the Americas brought to China by Europeans,[36] in fact it is difficult to find evidence of the dyestuff's use in Chinese textile production before 1800 (although it has been identified as the red pigment in depictions of red garments in Chinese ancestor portraits painted in the late eighteenth and early nineteenth centuries).

In Chinese culture the color red has traditionally been symbolic of happiness and prosperity, and it is used in many ritual and civil occasions, such as weddings and New Year celebrations. Beginning as early as the second century B.C., safflower red (made from the florets of the thistle plant *Carthamus tinctorius*) was used in China and throughout East Asia to dye silk in vivid pinks, reds, and pinkish oranges. At least since the Han period (206 B.C.–A.D. 220) madder root native to the region had also been used to produce a more orange-red color. But safflower pink is a fugitive color that fades readily upon exposure to light, and neither it nor madder orange had the brilliance of cochineal insect dye. Lac dyes from India and Southeast Asia produced a strong, bright red, but they were used sparingly in China and Japan, as accents rather than for whole red cloths. By the nineteenth century, as cochineal, or *yang hong* (foreign red) as it is called in Chinese, was more widely available, it was used more prolifically in Asia as the primary

68. Eadweard Muybridge (English, 1830–1904). *Cactus plantation for cochineal—San Mateo* [Guatemala], 1875. Stanford University Libraries (RBC:TR140 M97f no. 106a)

69. John Cohen (American, born 1932). Cochineal "baron" in the region of Ayacucho (right), with the town mayor and his assistant, Ayacucho, Peru, 1956

source of red dye. The ground cloth of a Chinese wedding banner in the Museum's collection that was made between 1850 and 1900 (fig. 67) is dyed entirely with American cochineal.

In Indonesia textiles have played an important role in the complex rituals and ceremonials of the hierarchical societies of the archipelago. The great achievements of the local dyers and weavers have for centuries been influenced by a rich cross-cultural exchange of ideas and designs gleaned from imported Indian silks and dye-painted cotton, Chinese silks, and ikat silk and other prestige trade cloth from neighboring Thailand, Burma, and Vietnam. For the red in their fabrics the Indonesian artisans used local dyes, lac from India, and eventually, especially after the establishment of the Dutch East India Company (Vereenigde Oost-Indische Compagnie, or VOC, in Dutch) in 1602, cochineal from the Americas. Cochineal was brought in via Canton or as a re-export from India, carried by English and Dutch ships. In the early nineteenth century, through efforts of the Dutch government, a plantation of American cactus, with live cochineal insect colonies taken from Mexico, was successfully established in Java.[37] The plantation thrived, producing nearly forty tons of cochineal red in 1845. As Java is known best for its fine cotton batik textiles, which would not have been dyed with cochineal, the dyestuff was most likely reserved for the silk yarns local artisans used to weave prestige cloth, the luxurious textiles that symbolized wealth and status.

In the attempt to maintain its monopoly over cochineal production, the Spanish Crown prohibited

70. Fragment of brocaded velvet with a repeated foliate double ogival pattern with pomegranates and rosettes (detail). Turkey, Ottoman period, 17th century. Silk dyed with American or Armenian cochineal, metal-wrapped thread; 60⅞ x 24⅝ in. (154.4 x 62.6 cm). The Metropolitan Museum of Art, Gift of Joseph V. McMullan, 1970 (1970.65.9)

71. Fragment of an ecclesiastical textile with winged seraphim heads (detail). Armenia or Greece, 17th century. Silk colored with cochineal (likely Armenian) and other dyes, 22½ x 43 in. (57.2 x 109.2 cm). The Metropolitan Museum of Art, Rogers Fund, 1908 (08.109.16)

72. Textile fragment with a pattern of columns of alternating scenes and Persian inscriptions (detail). Iran, Safavid period, 16th–17th century. Double-cloth woven dyed silk (the red cochineal), metal-wrapped thread; 25¾ x 14⅜ in. (65.4 x 36.5 cm). The Metropolitan Museum of Art, Fletcher Fund, 1946 (46.156.7)

73. Pieced fragments of brocade. Iran, Safavid period, 17th century. Compound twill weave silk, metal thread; 19¾ x 19 in. (50.2 x 48.3 cm). The Metropolitan Museum of Art, The Friedsam Collection, Bequest of Michael Friedsam, 1931 (32.100.461). Two red dyes were used in the textile: the nightingales' heads and flowers were dyed with safflower to produce a pink color, which has faded, while the wings of the birds were dyed with cochineal, which has by contrast remained bright red.

74. Rug. Iran, probably Kashan, Safavid period, 16th century. Silk, 96 x 65 in. (243.8 x 165.1 cm). The Metropolitan Museum of Art, Bequest of Benjamin Altman, 1913 (14.40.724). This rug was produced close to the heartland of the Armenian cochineal, which was used to dye the red silk pile.

the export of the live insects from Mexico well into the eighteenth century. Most of the reported surreptitious attempts to steal sections of cactus with live insects were thwarted by bad weather, delayed ship departures, shipwrecks, and other disasters. Perhaps the most famous of the cochineal thieves was botanist Nicolas-Joseph Thiéry de Menonville, whose clandestine journey to Oaxaca in 1776 was underwritten by the French government. Thiéry managed to buy live insects and some of their host cacti and then to smuggle his treasure first to Veracruz and then by sea to the French colony of Saint-Domingue (now Haiti).

75. Banner with inscriptions from the Qur'an and the Dhu'l Fiqar (the Prophet's sword). Turkey, Islamic, Ottoman period, dated A.H. 1225 (1810). Cochineal-dyed silk, metal-wrapped thread; 115¾ x 85½ in. (294 x 217.2 cm). The Metropolitan Museum of Art, Fletcher Fund, 1976 (1976.312)

Unfortunately, it did not flourish.[38] Nopal cactus and the parasitic cochineal insects were eventually successfully cultivated in Guatemala, where the crop even surpassed Oaxaca production levels (see fig. 68). The Spanish themselves sought to establish cactus plantations, or nopalries, in Iberia and in the Canary Islands, which are today still one of the primary sources of cochineal, along with Peru (see fig. 69).

The rise in the use of insect dyes in Europe coincided closely with the fall of Constantinople and the shift in relations between Turkey and Persia and the West. Persia, which exported its own kermes as well as kermes, or "cochineal," from neighboring Armenia, had by the end of the sixteenth century begun to import the American red dyestuff. Confusion over the names and identification of the different species of dye insects has made it difficult to explore the impact of its use in the region. Shipping records of the Dutch East India Company and the English East India Company indicate that ships brought American cochineal to Turkey and Persia in the seventeenth and eighteenth centuries. Two seventeenth-century textiles in the Metropolitan, a fragment of brocaded velvet from Turkey and part of an ecclesiastical robe from either Armenia or Greece (figs. 70, 71), were dyed with either Armenian or American cochineal. Evidence of American cochineal can also be found in products of the Safavid court weavers, such as two intricately patterned silk textiles and a rug in the Metropolitan Museum (figs. 72–74). The cochineal-dyed red silk panel of a banner that was meant to be carried either into battle by Ottoman troops or to Mecca by pilgrims

76. Coat. Turkmenistan, Islamic, mid-19th century or earlier. Silk embroidery on handspun red wool lined with machine-printed Russian cotton edged with cochineal-dyed ikat silk and bast fiber; 50¾ x 72½ in. (129 x 184 cm). The Metropolitan Museum of Art, Purchase, Hajji Baba Club and The Page and Otto Marx Jr. Foundation Gifts, in memory of Newton Foster, 1998 (1998.244)

(fig. 75) confirms that the dyestuff continued to find use in the 1800s.

In India, easy access to locally produced lac dye had fostered long-standing practices in textile production. The English began shipping cochineal to Surat soon after a textile factory was established there in 1612, but demand for it was slight until the nineteenth century. Following the pathways of the ancient trade routes, red insect dyes (of the Polish type) originating from Russia found their way via Bukhara into Kashgar in China and Kabul and Herāt in Afghanistan. Bukhara was also a distribution point for American cochineal, perhaps coming via Canton. By 1834, however, British explorer Alexander Burnes, a player in the struggle between the British and Russian empires for control of central Asia, was implying that in the markets of the Punjab in northwest India, American cochineal from the southern Indian ports had displaced the more local insect dyes obtained from Bukhara.[39] The lining of an embroidered coat from Turkmenistan (fig. 76) has been edged with nineteenth-century ikat silk that was resist-dyed locally with American cochineal.[40]

In Japan, conservative artisans persisted in the production of traditional textiles revered for their refined and sophisticated art forms. They utilized age-old processes to create dyed textiles in a variety of techniques including resist (*shibori*), stenciling, and hand painting. For the color red, which denoted both luxury and sensuality, the textile artisans kept to their traditional dye sources, safflower and Japanese madder (*akane*). One element of Japanese society did

77. House of Fortuny (Italian, founded 1906). Evening jacket. Venice, 1950s. Cochineal-dyed silk velvet stamped with silver, l. at center back 36½ in. (92.7 cm). The Metropolitan Museum of Art, Gift of The Duchess Pini di San Miniato, 1980 (1980.186b)

embrace the new colorant from the Americas: in the early seventeenth century a sleeveless jacket, or *jimbaori*, became part of the costume of high-ranking samurai. *Jimbaori*, which were meant to be worn over armor to protect itinerant warriors from the elements and also to display their family crests, were often made with imported fabrics, notably scarlet Dutch or English felted woolen plain cloth, dyed with either lac or cochineal.[41] And in the eighteenth century the use of insect red dyes became a distinctive tradition in Okinawa, where colorful cloth made with a special stenciling technique called *bingata* (insect red color) was dyed initially with lac imported from Southeast Asia and later, in the 1800s, with American cochineal.[42]

Although traditional methods of weaving and dyeing around the world were radically affected by industrialization and the introduction of synthetic dyes, cochineal continued to be used, albeit on a much smaller scale, into the twentieth century. In the late 1800s William Morris and other artists associated with the Arts and Crafts Movement in England experimented with traditional natural dyes, including cochineal. And in the early twentieth century Venetian textile designer Mariano Fortuny used silk colored with cochineal and other natural dyes to create luxurious garments like the plush red velvet cloak in the Metropolitan's collection (fig. 77). The cultivation of cochineal continues in Mexico, Peru, and the Canary Islands. The dyestuff is used in the modern cosmetic industry for lipstick and rouge, and carminic acid from cochineal insects, labeled Red E120, is added to foods and beverages to color them red.

Cochineal is a humble insect with a long and glorious history, and the treasures dyed and painted with its brilliant red hues bear witness to the contribution it has made to art and commerce throughout the world from antiquity to modern times.

NOTES

1. Faulkner 1990, p. 95, spell 99, part III. I am grateful to Christine Lilyquist and Catharine Roehrig for their comments on red in ancient Egypt.
2. Cinnabar was also identified in a related Warring States textile in the China National Silk Museum (analyzed by Guo Danhua; correspondence with F. Zhao and L. Jian, October 27, 2009).
3. R. A. Donkin (1977a, pp. 859–60) cites Genesis, Exodus, Leviticus, Joshua, and Hebrews. See also Forbes 1956, p. 104n22.
4. Donkin 1977a, p. 853. See also Cardon 2007, chap. 12.
5. Hofenk de Graaff 2004, pp. 102–3.
6. The primary chemical components of lac, kermes, and cochineal are distinctive and identifiable by scientific analysis. The main coloring compound in lac is laccaic acid, and in kermes it is kermesic acid. The primary component of Polish, Armenian, and American cochineal red is carminic acid. Polish cochineal can be distinguished from the other two because it also contains kermesic acid. In order to differentiate between American and Armenian cochineal, scientists have begun to quantify some of the secondary compounds in these two dyes (see, for example, Wouters and Verhecken 1989). One such compound is dcII, which is present in American cochineal and either missing or present in smaller quantities in the Armenian type. When dcII is present at certain levels, the source of the cochineal dye can be assigned to the Americas. Unfortunately, however, the compound is sometimes absent in dyes that are known to be American. For instance, dcII was not detected in the cochineal red used on some of the Precolumbian Peruvian textiles in the Metropolitan, which is clearly the American type. Why this is so remains to be investigated: It may be a question of whether the American cochineal was from wild or cultivated insects. Perhaps dcII disappears as part of the aging process in ancient and archaeological textiles. Or the sampling and analytical methods may be a factor. For this project, the results of the scientific analysis of the dyes have been assessed in relation to the historical context of the textiles themselves. Sometimes the logic of history allows a positive identification of the dye's source even when analysis of the chemical composition does not. In the text and captions here the term cochineal has been used in general to mean American cochineal, and Armenian cochineal is always referred to as such. In cases where science combined with art history cannot differentiate between the two, the result is labeled "Armenian or American."
7. Bernabé Cobo, *Historia del Nuevo Mundo* (1653, published as Biblioteca de autores españoles, vols. 91–92; Madrid, 1956), vol. 1, pp. 113–16.
8. For the *Matrícula*, see Castillo Farreras and Sepulveda y Herrera 1997.
9. Gonzalo Gómez de Cervantes, *La vida económica y social de Nueva España* (1599, published as Biblioteca Historica Mexicana de Obras Ineditas 19; Mexico City, 1944), p. 174.
10. Juan de Sámano, "Relación," published with Francisco de Xérez, *Verdadera relación de la conquista del Perú* [1527], edited by Concepción Bravo (Crónicas de América 14, Historia 16; Madrid, 1985); pp. 179–80; Miguel de Estete, "Relación de la conquista del Perú [1552]," in *Historia de los Incas y conquista del Perú* (Colección de libros y documentos referente a la historia del Perú, ser. 2, vol. 8; Lima, [ca. 1924]), p. 49.
11. See Cardon 2007 and Wouters and Rosario-Chirinos 1992.
12. See Saltzman 1986.
13. Eitel et al. 2005.
14. Felipe Guaman Poma de Ayala, *El primer nueva corónica y buen gobierno* (1615–16), edited by John V. Murra and Rolena Adorno; translated by Jorge L. Urioste (Mexico City, 1980), pp. 81, 121.
15. Recent analysis of an Inca tunic in the Museum of Fine Arts, Boston (47.1097), found that both the red in the yoke and the black in the checkerboard design contained cochineal dye (correspondence with Meredith Montague, December 28, 2009).
16. See Phipps 2003 and also note 14 above.
17. Juan de Betanzos, *Narrative of the Incas*, translated and edited by Roland Hamilton and Dana Buchanan from the 1557 Palma de Mallorca manuscript (Austin, 1996), p. 63.
18. Baltasar de Ocampo, "An Account of the Province of Vilcapampa and a Narrative of the Execution of the Inca Tupac Amaru" (1610), in *History of the Incas by Pedro Sarmiento de Gamboa and The Execution of the Inca Tupac Amaru by Captain Baltasar de Ocampo*, translated, edited, and with notes by Sir Clements Markham (Cambridge, 1907; reprinted Mineola, N.Y., 1999), pp. 226, 224.
19. Bancroft 1814, vol. 2, p. 295.
20. "Statuti et ordini della magnifica città di Pistoia sopra il vestire delle donne: pubblicati il dì diciotto settembre MDLVIII" (1558, reprint 1750), p. 2, Getty Special Collections Research Library, SP 1395-512 folio 10: "non possin delle donne portare di forte aluna veste Turche, Simarne o tabarri de pano Luchesino o de Grana + quelle che fino."
21. Lee 1948, p. 453, citing Antonio de Herrera y Tordesillas, *Historia general de los hechos de los castellanos en las islas y tierra firme del mar oceano* (2nd ed., edited by Andrés González de Barcía Carballido y Zúñiga (Madrid, 1730 [first published 1601]), decada III, lib. 5, cap. iii.
22. See Born 1938, p. 217.
23. Lee 1951, p. 222.
24. Delmarcel and Duverger 1987, no. 11 (Musées Communaux, Bruges, 78.1 XVII). See also Wouters and Verhecken 1989.
25. Lee 1951, p. 223; Munro 1983, pp. 13–70.
26. Duits 1999, p. 63.
27. Giovanventura Rosetti, *The Plictho: Instructions in the Art of the Dyers . . .* , facsimile of the 1548 ed., translated by Sidney M. Edelstein and Hector C. Borghetty (Cambridge, Mass., 1969), p. 136. On Rosetti's treatise, see also Molà 2000, pp. 107ff. Testing revealed that a fourteenth-century Italian silk in the Museum (46.156.29) was dyed with a mixture of madder and kermes.
28. Molà 2000, pp. 121–22, citing Massa 1974, app. 27, p. 286.
29. Molà 2000, p. 129.
30. Tommaso di Iacopo de' Medici to Vincenzo Ambrogi, September 14, 1566, and February 12, 1571, Medici Archive Project, http://documents.Medici.org, vol. 221, fols. 25, 91, documents 13622, 13872.
31. Lee 1951, p. 223.
32. Hellot, Macquer, and Lepileur d'Apligny 1789, p. 125.
33. Ellis [1798], chap. 2, p. 15.
34. See Wheat and Hedlund 2003 for further information.
35. Lee 1951, pp. 211–12.
36. Donkin 1977b, p. 39.
37. See ibid.
38. Nicolas-Joseph Thiéry de Menonville, *Traité de la culture du nopal et de l'éducation de la cochenille dans les colonies françaises de l'Amérique, précédé d'un voyage à Guaxaca* (Paris and Bordeaux, 1787). The story has been recounted by many scholars; see, for example, Finlay 2002, pp. 150–60.
39. Burnes 1834, vol. 2, p. 434, cited in Donkin 1977b, p. 39. See also Donkin 1977a, pp. 857–58.
40. A rare early eighteenth-century ikat silk from Bukhara that is now in the Museum's collection (30.10.13) was found to have been dyed with lac, which would have been imported into the region over the ancient silk routes, perhaps via India.
41. The strips of red felted wool that decorate the shoulders of a late seventeenth-century *jimbaori* in the Metropolitan (2006.95) were found to have been dyed with lac.
42. The red elements in the design on a *bingata* silk robe from Okinawa in the Metropolitan (1983.417a,b) that has been dated to the nineteenth century were tested and found to have been dyed with lac.

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Scientific Analysis

The identification of the dye components in the objects pictured in this *Bulletin* was based on analyses that in all but a few cases were carried out by scientists in the Museum's Department of Scientific Research. Nobuko Shibayama was responsible for testing the majority of the objects in the Metropolitan's collection, with the following exceptions: figs. 1, 5, 7, 27, and 60 were analyzed by Marco Leona; fig. 2 by Marco Leona and Yae Takahashi; fig. 3 by Mark Wypyski; figs. 36 and 40 by Jan Wouters (formerly at the Institut Royal Patrimoine Artistique, Brussels); fig. 61 by Silvia Centeno; and fig. 74 by Jan Wouters and Won Ng (formerly in the Textile Conservation Department at the Metropolitan). Jo Kirby (National Gallery, London) conducted an analysis of fig. 60 in 1995.

As the author, I take responsibility for the interpretation of the scientific data as it is presented here.

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