

Raveled Insect-Dyed Yarns in Blankets of the American Southwest

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THE SOUTHWESTERN LANDSCAPE is infused with red. Derived from iron oxide and other minerals, red hues appear in soil, rocks, cliffs, and rivers. Native Americans who lived in the Southwest thousands of years ago created textiles, pots, and baskets in reddish and orangey browns from earthen sources. By the 1700s they were also using vermilion, a mineral pigment from cinnabar (mercuric sulfide) that appears in European and American trade records and that imparted a deep red to deerskin, fabric, and other materials.

Beyond mineral-based red-browns, plant-derived colorants from alder tree bark, mountain mahogany root bark, black sunflower seeds, purple corn, and other plants added reds, pinks, and purples to the indigenous palette. By the 1880s, brighter and more versatile reds had arrived in the form of European, coal tar-based synthetic colorants. Trade cloth tinted with these aniline red dyes had come into use in the West by the late 1800s, as native and other craftspeople edged or lined garments and bags with it and found other uses for such cloth. (See Bol, this volume.)

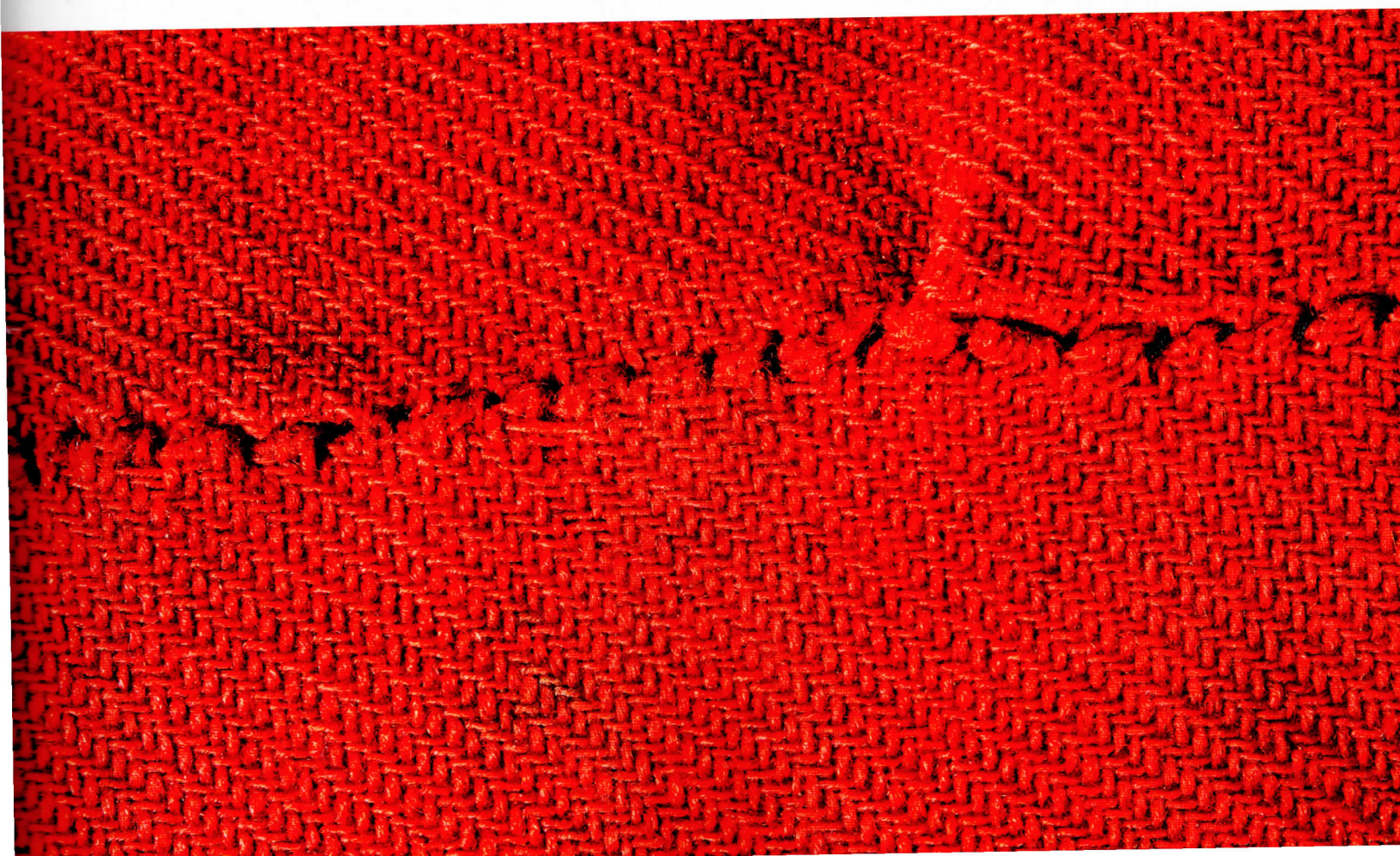
The most interesting source of red, however, was cochineal bugs. The earliest known appearance of cochineal-dyed yarns in the Southwest is in fragments of Navajo dresses (*biil*) and blankets (*beeldléi*) found in historic-period archaeological sites dating from the 1790s to the early 1800s.¹ These reds made their way into Navajo blankets and garments, as well as into nonnative southwestern textiles, in a roundabout manner—only after foreign, manufactured yarns and cloth were dyed with imported cochineal and exported to North America (figures 18.1a–18.1b and 18.2).

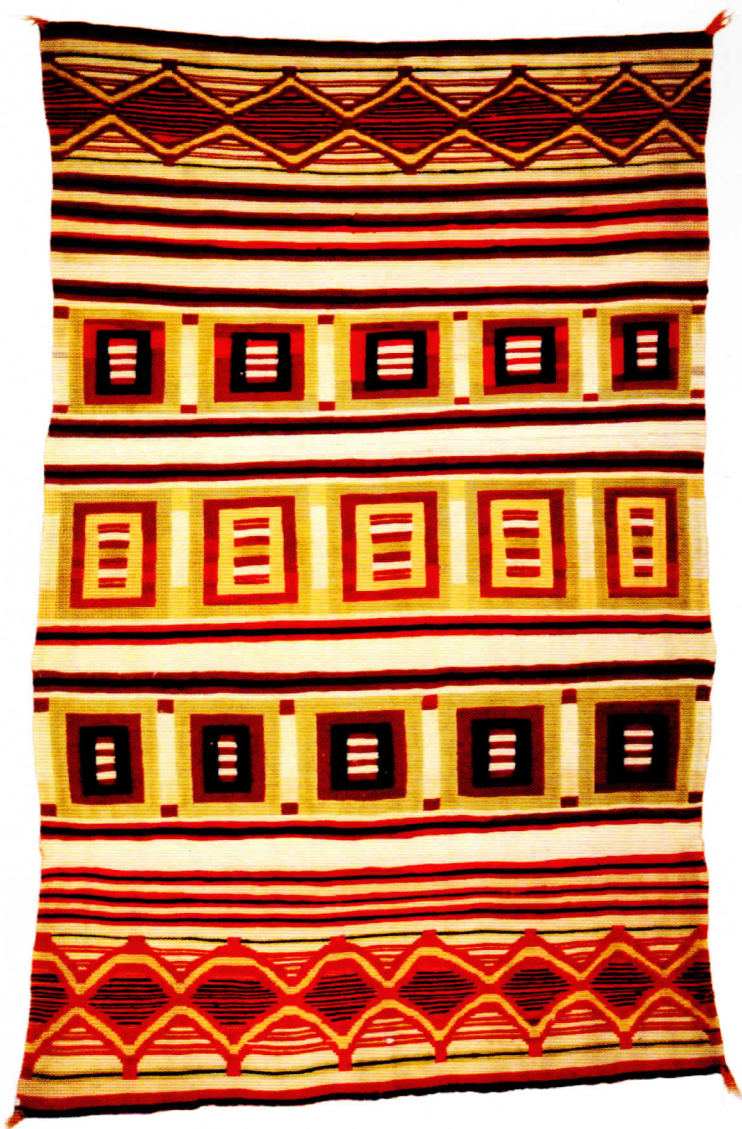
Beginning in the early 1500s, dried cochineal insects were shipped in enormous quantities and at high expense, from Mesoamerica to Spain and beyond, where their extracted dyes were applied to commercial wool yarns and fabrics of

European and Near Eastern manufacture. (See Marichal, this volume.) Commercially woven wool fabric first entered the Southwest among the supplies of early Spanish explorers, such as Francisco Vázquez de Coronado, beginning in 1540. After 1598 lengths of trade cloth reached the Southwest via El Camino Real de Tierra Adentro from Mexico, and after 1821 along the east–west Santa Fe Trail. Eventually, European and Near Eastern imports were augmented by Mexican and American mill products. Known generically as *bayeta* in Spanish or baize in English, the flannel-like materials varied in weave, texture, yarn structure, and finish, with their universal popularity attributed to their brilliant reds (figures 18.3–18.4).²

By the late 1700s, both Native American and Spanish American weavers in the Southwest were obtaining lengths of red trade cloth and skeins of red yarn—some of it dyed with cochineal originally exported from Mesoamerica and applied to fibers in Europe and the Near East. The cloths were recycled by unraveling or further hand processing and were rewoven into Pueblo (figure 18.5), Navajo, and Hispanic textiles. But several long-standing issues and questions remain. These include whether the presence of wild cochineal insects in the Southwest today indicates a local source for dyeing; whether the cochineal dyestuff cultivated and prepared in Mesoamerica entered the Southwest in sufficient quantities for application to local hand spun yarns;

Opposite **FIGURES 18.1A–18.1B** Kit Carson robe, Taos, New Mexico, pre-1850. Beaver pelt mantle lined with red wool fabric. Balanced diagonal twill weave (2/2), mill-woven, with red S-spun warp and weft yarns, mill-spun and dyed with 100 percent cochineal, 60 x 53 in. New Mexico History Museum, Department of Cultural Affairs, 09474.45. According to museum records dated March 16, 1929, this plush beaver robe was made in the Carson family before 1850, possibly by Kit Carson himself. This was the period when the legendary and controversial trapper, scout, and soldier trapped beaver in New Mexico. Depicted here are the full robe's fur exterior and a detail of its hand-stitched red wool lining made from imported trade cloth.





Above **FIGURE 18.2** Navajo sarape, Navajo Nation, Arizona or New Mexico, late Classic period, ca. 1864–1875. Maroon, red, and pink raveled wool weft yarn (two–three Z-spun strands) dyed with 100 percent cochineal; pink Saxony wool weft yarn (3zS) dyed with 100 percent cochineal, 77 x 50 in. Arizona State Museum, E-2853. Photo: Arizona State Museum, University of Arizona.

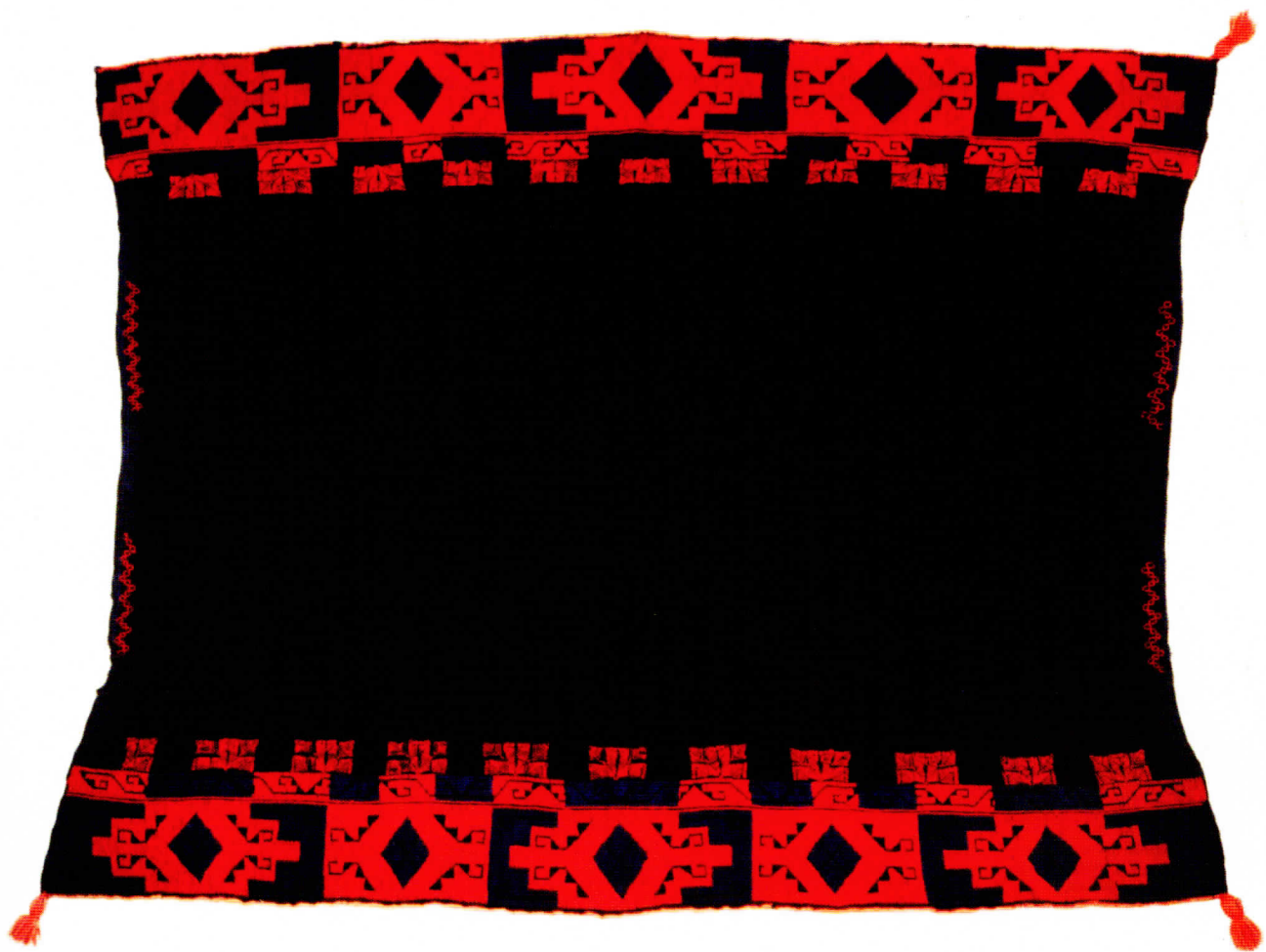


Right, top **FIGURE 18.3** Navajo chief blanket, Phase I variation, Navajo Nation, Arizona or New Mexico, ca. 1850–1865. Red raveled wool weft yarn (three–four S-spun strands) dyed with 100 percent cochineal, 59½ x 74 in. Museum of Indian Arts and Culture, Laboratory of Anthropology, 9118/12.



Right, bottom **FIGURE 18.4** Navajo sarape with small poncho neck slit, Navajo Nation, Arizona or New Mexico, Classic period, ca. 1840–1860. Red raveled wool weft yarn (Z-spun, paired) dyed with 100 percent cochineal, 65½ x 51 in. Arizona State Museum, E-2724; Joe Ben Wheat Southwest Textile Database ID 58. Photo: Arizona State Museum, University of Arizona.

Opposite **FIGURE 18.5** Manta, Acoma Pueblo, New Mexico, ca. 1860–1880. Red raveled wool weft yarn (2zS) dyed with 80 percent cochineal and 20 percent lac, 44 x 58 in. Arizona State Museum, E-9990. Photo: Arizona State Museum, University of Arizona.



and whether other insect dyes, such as Indian lac and Mediterranean kermes, were present in the raveled reds. Furthermore, by what processes did people transform trade cloth into a creative resource? How varied were the materials and how can they be used as diagnostic tools to identify and date undocumented textiles today?

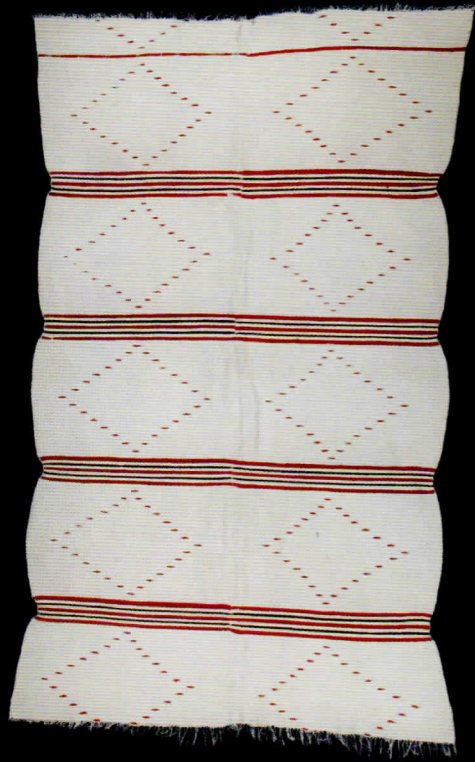
COCHINEAL DYESTUFF IN THE AMERICAN SOUTHWEST?

Two types of cochineal are distinguished in modern-day Mexico: fine cochineal (*Dactylopius coccus*) and eight species of wild cottony cochineal, including *Dactylopius opuntiae*.³ Through time, human-driven selection enlarged the insect's body size and diminished its waxy white protective covering, which allows the insect to adhere to its prickly pear host and makes it resistant to wind and rain. This process of domestication thereby increased the relative amount of carminic acid as a source for red dye.

In addition to the widely known presence of cochineal on various prickly pear cacti in Mesoamerica and South America, the American Southwest hosts a native or wild bug of

the same genus, albeit much smaller and not domesticated. Indeed, whereas yields from *D. coccus* are 15 to 25 percent, wild cochineal yields a much lower concentration of carmine colorant, from 2 to 7 percent by dry weight.⁴ Identified in southern Arizona and Mexico as *Dactylopius opuntiae*,⁵ the insect lives on local, native prickly pear species such as the widespread *Opuntia engelmannii* and sometimes on non-native prickly pears in area gardens. Facing an infestation of this parasite, urban and rural gardeners may be advised by local nurseries to hose off the white substance in which the insects encase themselves. With the slightest touch, the cottony mass exudes a brilliant spot of red.

The western U.S. range for prickly pears, and presumably for native wild cochineal, stretches from California to Texas and from Colorado to the Mexican border. The distribution includes the Hopi Indian mesas in Arizona, the Navajo Nation of Arizona and New Mexico, and parts of New Mexico where Pueblo Indian and Hispanic villages have been located for hundreds of years. Cochineal's presence appears to be ecologically constrained but not culturally governed, as there is no indication of cochineal domestication in the Southwest.



The wild bugs were thought to be too small and proportionately too waxy for productive use as a dyestuff.⁶

In addition to the wild bugs' physical limitations, no concrete material evidence shows that local insects were harvested for dyes to be applied on textiles produced by Pueblo, Navajo, or Spanish American weavers. There have been no confirmed textile examples of hand-spun yarn in which fibers were locally dyed with cochineal or other insect dyes, nor has any documentary, ethnographic, or known anecdotal evidence of such dyeing practices in the Southwest been reported to date. Furthermore, there is no archival or ethnographic support for insect-based dyestuffs being imported to the Southwest for application on Pueblo and Navajo textiles before the twentieth century.⁷

During their early research, Kate Peck Kent and Joe Ben Wheat each considered the possibility of imported cochineal being used by Navajos as a native-applied dyestuff, but both later rejected this notion. Wheat summarized his point of view in a 1982 letter to Kent: "I have never seen a Navajo native-spun yarn dyed with cochineal, nor have I ever found any documentary evidence that they even used cochineal. Documents in the 1865 period flatly state they dye only with indigo, using yarn and bayeta for all other colors."⁸

The case for cochineal dyeing is just as tenuous in Spanish American textile production and records. The argument for active cochineal dyeing in New Mexico during the nineteenth century reaches back to the Spanish colonial arts revival period of the 1920s and 1930s in New Mexico, when local preservationists sought to revive and perpetuate artistic techniques and materials presumably used during the colonial period. E. Boyd, writing in the 1950s, carried forward assumptions about the local use of cochineal. Seeking evidence for the raw dyestuff in New Mexico, Ward Alan Minge

noted "pounds of *carmesí* (cochineal)" among the many goods listed as being brought from Mexico to New Mexico. It is unclear whether this information derived from a single document or multiple sources, where the record occurred, or how the original Spanish wording appeared.⁹ Subsequent articles have generalized and expanded on Minge's statement: "Documents record the importation of pounds of *carmesí* (cochineal) into New Mexico in the 1830s."¹⁰ Wheat repeats this as well, although it is unclear whether he is discussing the dyestuff or already dyed yarns and fabric.¹¹

Complicating matters, it was common in the twentieth century to interpret the term *vermilion* to mean cochineal in historical documents.¹² This is likely a mistranslation and may obscure reality—when the term *vermilion* is ignored, there is little mention of cochineal in trade records. When cochineal does appear, it seems insufficient in quantity for yarn or fabric dyeing and was likely used for painting, making cosmetics, or other small-scale activities. (See Gavin and Caruso, this volume.) Although cochineal was used as a lake pigment in Spanish colonial paintings in New Mexico (see Anderson; Siracusano and Maier; and Pearlstein et al., this volume), Mexican trade records mention the red colorant in relatively small amounts.¹³ It is doubtful that enough would have been released from Spanish control for use as a textile dye.¹⁴

ANALYZING RED DYES IN SOUTHWESTERN TEXTILES

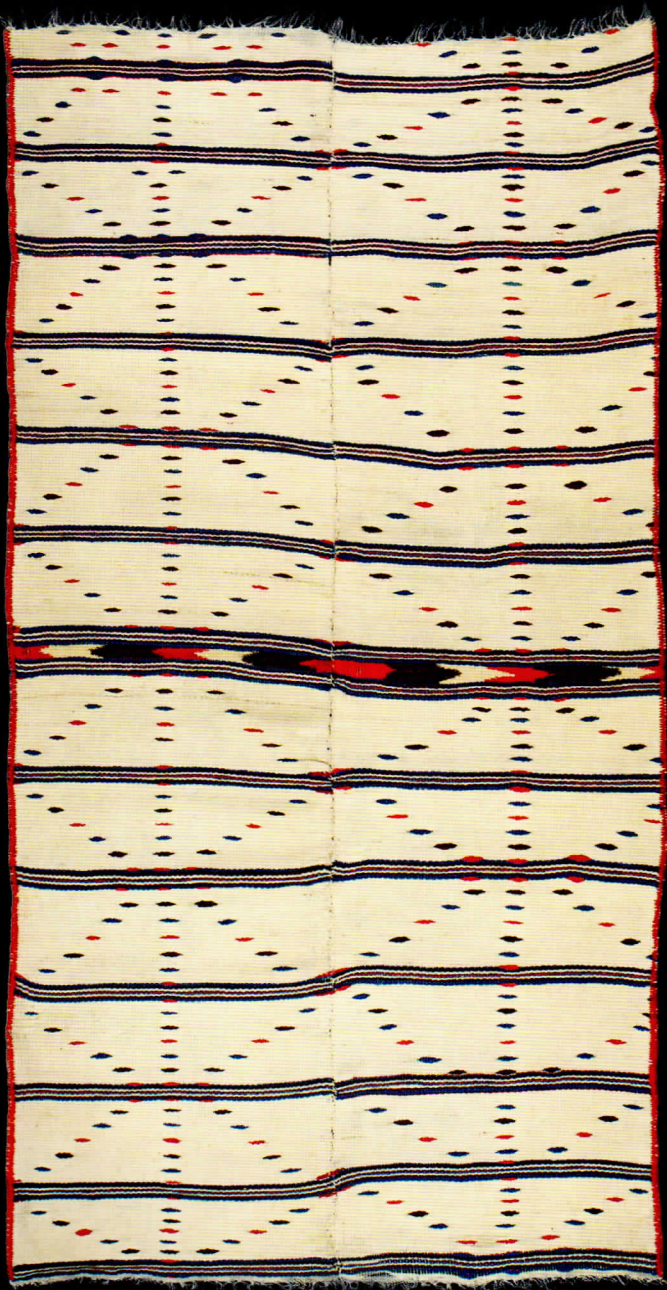
When did Southwest textile scholars begin investigating cochineal and other red dye sources in raveled yarns from red cloth? Washington Matthews describes *bayeta* and mentions raveled yarns but makes no mention of any source for the "bright scarlet." Charles Amsden, citing U. S. Hollister as his authority, casually recognized cochineal as "the usual colorant of bayeta." For his part, Hollister gives no clues to his source. George Pepper mentions *bayeta* as a source of "a rich lasting red" but refrains from specifying the dyestuff. And H. P. Mera's commentary on Navajo "ravelings" from *bayeta* mentions cochineal in passing only as a pre-aniline dye.¹⁵

The first analytical confirmation of cochineal in southwestern textiles occurred in the 1970s when industrial chemist Max Saltzman consulted with the Museum of International Folk Art on a pioneering study of nineteenth-century New Mexican Hispanic Rio Grande blankets and *colchas* (embroidered bed coverings). Working with museum textile curator Nora Fisher, he tested fifty-five samples using spectrophotometric analysis in the ultraviolet and visible spectra. In their summary, the pair report that "all of these samples of

Opposite, left, top **FIGURE 18.6** Spanish American blanket, Lemitar, Rio Abajo, New Mexico, ca. 1800–1850. Native hand-spun white cotton warp (2zS) and weft (Z-spun, singles); cotton said to have been grown at Lemitar. Dark pink mill-spun wool weft yarn (very fine 3sZ, reverse direction of Saxony spinning) dyed with 100 percent cochineal, 78 x 46 in. Museum of Northern Arizona, 2203/E1870; Joe Ben Wheat Southwest Textile Database ID 1051.

■ Opposite, right **FIGURE 18.7** Vallero star blanket, Spanish American, Rio Grande Valley, New Mexico, ca. 1855–1870. Red Saxony wool weft yarn (3zS) dyed with 100 percent cochineal, 90 x 46½ in. Museum of International Folk Art, IFAF Collection, FA.1967.43.3.

Opposite, left, bottom **FIGURE 18.8** Spanish American blanket, Rio Grande Valley, New Mexico, ca. 1820–1850. Native hand-spun white cotton warp (2zS) and weft (Z-spun, singles). Red raveled wool weft yarn (one-two Z-spun strands and 2zS) dyed with 100 percent lac, 98 x 45 in. Collection of the Spanish Colonial Arts Society Inc., Museum of Spanish Colonial Art, L.5-62-74; Joe Ben Wheat Southwest Textile Database ID 1003. Photo: Addison Doty, courtesy Museum of Spanish Colonial Art.



Above **FIGURE 18.9** Spanish American blanket, Rio Grande Valley, New Mexico, ca. 1820–1850. Bundled strips of red raveled wool weft yarn (five-eight S-spun strands) dyed with cochineal. Red raveled wool fibers dyed with cochineal and spun with white wool (Z-spun). Dull red raveled wool weft yarn (Z-spun), 84 x 43 in. Museum of International Folk Art, A.1964.76.1.

■ **Opposite FIGURE 18.10** Spanish American blanket, Rio Grande Valley, New Mexico, ca. 1860–1870. Red Saxony wool weft yarn (3zS) dyed with 100 percent cochineal, 70¼ x 44¼ in. Museum of International Folk Art, FA.1969.15.1.

cochineal-dyed yarn are commercially prepared 3- and 4-ply yarn.” In the same volume, Dorothy Boyd Bowen and Trish Spillman note that “cochineal appears mainly in imported commercially dyed factory-spun yarn” (figures 18.6–18.7). Along with the confirmation of cochineal in raveled yarns came the surprise that lac (*Laccifer lacca*), an insect dye from southern Asia, was sometimes present instead of (figure 18.8), or in combination with, cochineal.¹⁶

Meanwhile, by 1972 Joe Ben Wheat had embarked on his groundbreaking long-term study of more than thirteen hundred Native American and Spanish American textiles from public collections. This work led to his collaboration with a Museum of International Folk Art team on Hispanic textiles and his contribution of several chapters to *Spanish Textile Traditions of New Mexico and Colorado*. In the book, as exceptions to their findings of cochineal in commercially dyed and spun yarns, Bowen and Spillman presented two blankets with single-ply wool wefts described as hand-spun wool and tested by Saltzman as 100 percent cochineal-dyed. Wheat analyzed the first in 1973, identifying the red crimson yarn as “handspun wool” but qualifying the description with a footnote: “Some of this in the diamonds resembles raveled.” In the same textile, the presence of a single-ply pink yarn presumed to contain cochineal (not tested) substantiates the presence of raveled materials and puts the hand-spun designation in question.¹⁷ The second blanket contains “bundled strips of cochineal[-dyed wool] and cochineal[-dyed wool] ‘fuzz’ spun with white weft,” attesting again to the presence of raveled materials (figure 18.9).¹⁸

In 1981, following Saltzman’s successful use of spectrophotometric tests, David Wenger, a medical researcher with expertise in textile analysis, began working with Wheat to test well-documented Pueblo, Navajo, and Hispanic blankets. This work led to the characterization of three-ply saxony yarns as 100 percent cochineal-dyed (figure 18.10) and to the identification of cochineal and lac used in specific proportions in raveled yarns (figure 18.11).¹⁹ Cultivated for its dye properties on certain oak and other trees in India and the Near East, and introduced to England in 1796, lac was reported by Bancroft in 1814 to be more lightfast and cheaper than cochineal. These qualities, plus its duller hue, prompted the combining of lac with cochineal on commercial European yarns. According to research by biologist Harold Colton, lac insects also grow in the American Southwest, on creosote bushes, but they reportedly have no usable dye properties.²⁰

Ultimately, Wenger tested around 350 samples from more than three hundred textiles. The brief histories, descriptions,





analyses, and images of these and other textiles from more than forty public collections are available online at the Joe Ben Wheat Southwest Textile Database.²¹

Kermes (*Kermes vermilio*), an insect from the Mediterranean region of southern Europe and Turkey, represents a third historically and technologically significant source of insect-based red dye. Containing about one-tenth (1 to 2 percent) of the coloring matter per volume of dried insect of cochineal (10 to 20 percent), kermes red is sometimes compared in hue to the mineral-based vermilion red pigment.²² According to Ana Roquero, the insect was well-known to the Spanish textile industry, with kermes-dyed wool fabrics exported to Mexico from Spain at least during the mid-sixteenth century.²³ This led some researchers to question whether kermes-dyed yarns might have appeared in the Southwest.

Above **FIGURE 18.11** Navajo twill-woven manta, Navajo Nation, Arizona or New Mexico, ca. 1870–1875. Red raveled wool weft yarn (S-spun, paired) dyed with cochineal (54–55 percent) and lac (45–46 percent). Coral pink raveled wool weft yarn (Z-spun, singles) dyed with synthetic, 31 x 47 in. Arizona State Museum, E-2859; Joe Ben Wheat Southwest Textile Database ID 94. Photo: Arizona State Museum, University of Arizona.

■ **Opposite FIGURE 18.12** Navajo sarape, Navajo Nation, Arizona or New Mexico, late Classic period, ca. 1865–1875. Red raveled wool weft yarn (two shades/types, both Z-spun) dyed with 100 percent cochineal. Red mill-spun wool weft yarn (three shades/types, all 3zS) likely dyed with 100 percent cochineal, 73 x 52 in. Museum of Indian Arts and Culture, Laboratory of Anthropology, 9108/12.

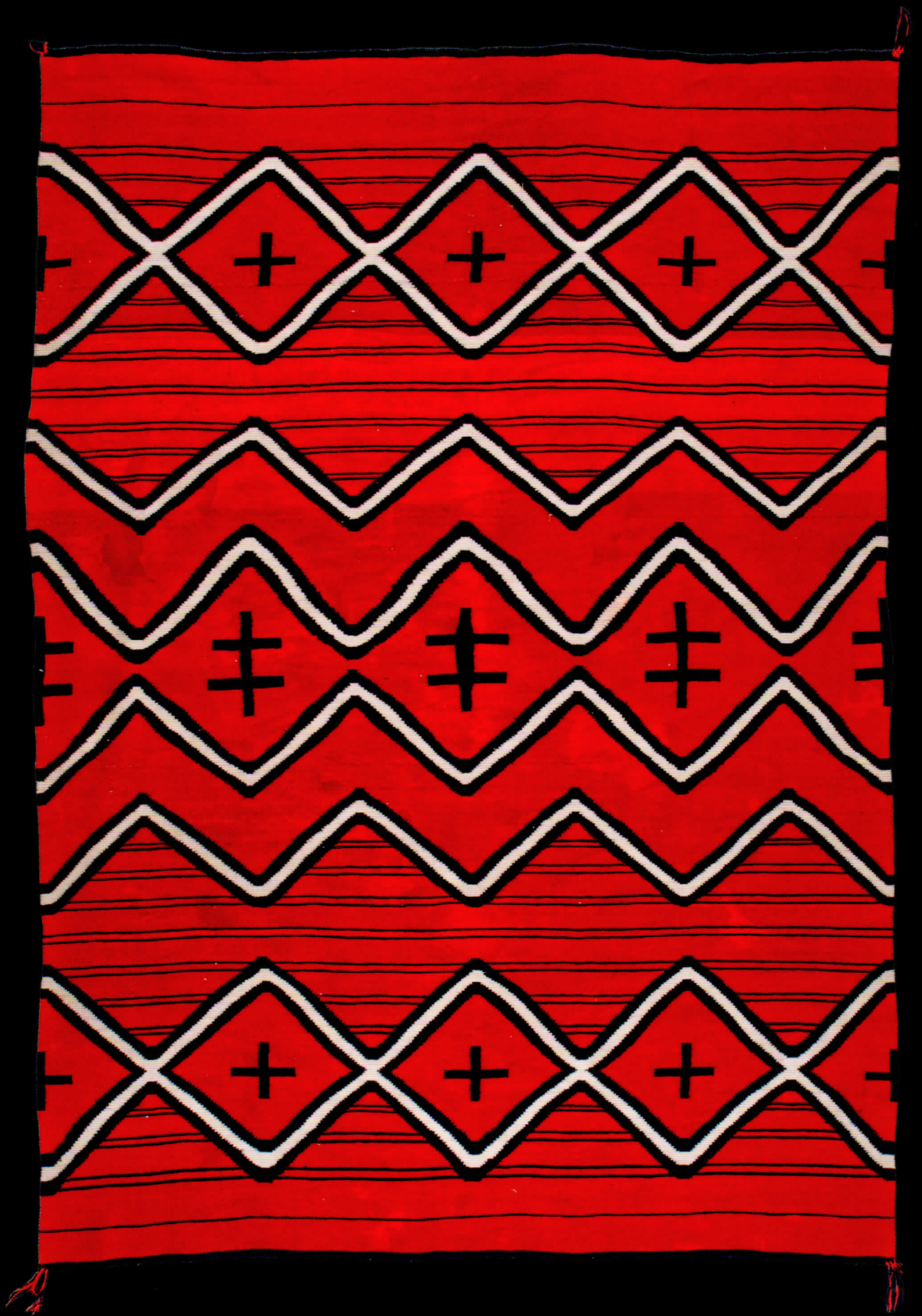
But standard spectrophotometric analysis cannot distinguish between cochineal and kermes; the two diverge chemically on the basis of one glucose (sugar) molecule. If kermes was present in any of the raveled southwestern reds, it would not be revealed through spectrophotometry. In 2006 Kathleen Duffy sought and developed more sensitive measures by changing dye extraction methods and using high-performance liquid chromatography (HPLC) in addition to spectrophotometry. Duffy successfully analyzed samples from the Arizona State Museum textile collection to show that kermes was not present and can likely be excluded from the southwestern record.²⁴

Other efforts to identify insect dyes in southwestern textiles have produced corroborating results.²⁵ Thus, based on present knowledge and lacking contradictory data, it appears that red wool materials found in southwestern textiles that were dyed with cochineal, with or without lac, were obtained from already spun yarns colored with sources from outside the American Southwest.

UNRAVELING RED CLOTH

As early as 1787, historical documents show the Spanish government placing orders for *vaieta de grana*, or cochineal-dyed *bayeta* cloth, to reward certain Navajo Indians “because of good conduct.” Wheat’s studies of historical documents found numerous names and descriptions of the specific types of





fabric that may have been unraveled. Defining the cloth contextually rather than by its particular physical properties, he concluded, “The term *bayeta* should be used for any cloth that was raveled to provide colored threads” in Native American and Spanish American weaving.²⁶

Unraveling cloth to obtain usable threads for other projects is not unique to the Southwest.²⁷ (See Osborn on African unraveling, this volume.) However, Pueblo, Navajo, and Spanish American weavers achieved remarkable feats of recycling—unraveling yarns from whole *bayeta* cloth and reweaving them into their own handwoven fabrics. Studies of raveled yarns in extant Native American and Spanish American blankets and garments have revealed suites of characteristics that shift nearly decade by decade through the nineteenth century. The variations reflect the ever-changing nature of the trade cloths themselves and were likely due to different trade sources, evolving industrial practices, and other historical and technological factors.


From empirical evidence, extant yarns unraveled from *bayeta* and rewoven into handmade southwestern textiles can be characterized by direction of spin (S or Z); relative quality (fine, medium, or coarse) and size; and use as singles or multiples (from pairs to as many as ten). Other factors include the worsted (straight, smooth) or woolen (fuzzy, spiraling) quality of spinning; dyes (cochineal, lac, a combination, or synthetics) and their penetration (solid or speckled); color saturation (deep or light); and tones (crimson, scarlet, pinks, and purples).²⁸

How was the recycling of yarns and fibers actually accomplished? Although records have not revealed the specifics of how southwestern weavers unraveled *bayeta* fabrics, some probable techniques can be reconstructed through analysis of extant historic fabrics, logical speculation, and experimentation with new materials. For the recarding of fibers into multicolor specialty yarns, such as pinks and heathered grays, twentieth-century documentation of practices among southwestern weavers shows the way (see figure 18.9).

Unraveling fuzzy wool yarns from whole cloth is a sticky process, particularly where the cloth’s surface has been brushed, fulled, or felted to any degree. Unraveling even a smooth cotton cloth to produce fringe along a hem attests to the ways in which warp and weft yarns bind together to thwart the unraveler. British textile writer Jessica Hemmings uses the term *unpicked* to describe the unweaving of cloth.²⁹ Given that each pass of weft through a loom’s warps is called a pick in weaverly jargon, this term for undoing the fabric is apt.

Cutting cloth into strips represents the most efficient, and least wasteful, approach to obtaining raveled yarns for weaving, and surplus wool fibers for carding, newly hand-spun yarns. It is logical that southwestern weavers unraveled imported *bayeta* cloth by cutting it into narrow strips and pulling the short ends from the fabric. This would automatically result in a hank of parallel threads that were relatively easy to handle as a weft bundle. The long raveled strands were used singly if their weight matched that of the weaver’s hand-spun wool yarns. Alternately, from two to as many as ten strands were incorporated into the weaving as a loose bundle of yarns. The short leftover strands removed from the cloth strip could be carded together with locally sourced white wool (or that of sheep of other colors) to produce a blended pink. They could also have been recarded and respun into solid red yarns.

Evidence is clear for Navajos cutting narrow pieces of imported fabric to create intact cloth strips for weaving, much like those used in rag rugs. This was also done by Spanish American weavers (see figure 18.9). H. P. Mera devotes a chapter to the subject of “cloth-strip blankets of the Navajo.” Showing the original fabrics’ over-under structure of plain weave, or the diagonal texture of twill weave, these strips appear prominently in a number of handwoven Navajo blankets. Sometimes the edges of the cloth frayed, resulting in a chenille-like quality, which Wheat alternately called heavy terry cloth, Turkish towel, or tufted. Both Mera and Wheat discussed this technique as a relatively late phenomenon, restricted to the 1870s and 1880s, though neither author extrapolated the original way in which most, if not all, raveled yarns likely were obtained. Wheat verged on this notion when he analyzed one saddle blanket “in which [the] principal material consists of strips of raveled flannel with most [but not all] of the cross threads removed.”³⁰

The prodigious efforts of Native American and Spanish American weavers to obtain red from foreign sources represent a fascinating story. Clearly, imported *bayeta* cloth provided a ready material for southwestern ingenuity. Today, cochineal-dyed yarns in historic southwestern textiles serve as critical diagnostics for dating undocumented textiles and identifying their cultural contexts (figures 18.12–18.13). Beyond technological feats, these labors emphasize the aesthetic appeal of red and the artistic intent of many nineteenth-century weavers. 

■ **Opposite FIGURE 18.13** Navajo sarape with small poncho neck slit, Navajo Nation, Arizona or New Mexico, mid-Classic period, ca. 1865. Red raveled wool weft yarn (one–two S-spun strands) dyed with 100 percent cochineal, 72 x 48 in.; slit length 4½ in. Courtesy of The Owings Gallery, Santa Fe, New Mexico.

natural dyes (including probably cochineal) and no running of the colors whatsoever. The other specimens, Mazahua embroideries at the MTO and other collections that date to the nineteenth century, display only stable reds and magentas, along with other fast colors.

63. Wallert, "Analysis of Dyestuffs," 76.

64. Museo Nacional de Antropología, Mexico City, catalog number 24253(59)6.37al-40. Irmgard Weitlaner Johnson, who curated the textile collection of the MNA in the 1950s and 1960s, told me in 1985 that the original accession card for this piece did not record its provenance or ethnic group. Lorena Román, who cleaned and restored this *huipil* at Escuela Nacional de Conservación, Restauración y Museografía, confirmed that cochineal was used to dye the silk weft and to paint the cotton warp in the top section of the central web; Lorena Román Torres, personal communication, November 14, 2014.

65. Van Dam, "Species Delimitation," 39–44.

CHAPTER 16 (CARDON)

1. Dominique Cardon, *Mémoires de teinture: Voyage dans le temps chez un maître des couleurs* (Paris: CNRS Editions, 2013), with color plates illustrated with samples.

2. Jacques Savary, *Le Parfait négociant* (Geneva: Droz, 2011), 1074, 1120. All translations from French to English in this paper are done by the author.

3. Cardon, *Mémoires*, 90.

4. Dominique Cardon, *Natural Dyes: Sources, Tradition, Technology, and Science* (London: Archetype Publications, 2007), 47–48.

5. Well defined by Philippe Minard, "Réputation, normes et qualité dans l'industrie textile française au XVIII^e siècle," in *La Qualité des produits en France (XVIII^e–XX^e siècles)*, ed. A. Stanziani (Paris: Belin, 2003), 69–89.

6. William Partridge, *A Practical Treatise on dying of woollen, cotton and skein silk, with the Manufacture of broadcloth and cassimere including the most improved methods in the West of England* (Edington, UK: Pasold Research Fund, 1973), 184; Cardon, *Mémoires*, 354, table 8.

7. Document C 5569, 1734, Archives

départementales de l'Hérault, Montpellier, France; Cardon, *Mémoires*, 250.

8. After weaving, the pieces were cut into two halves that were dyed and finished separately, which made dyeing and finishing operations comparatively easier for workers (but the half pieces still weighed between 10 and 12.5 kilograms dry) and allowed for a wider selection of colors in one bale; Cardon, *Mémoires*, 219–20, 247.

9. Document C 5552, 1751–1753, Archives départementales de l'Hérault, Montpellier, France.

10. Document C 2230, 1758, Archives départementales de l'Hérault, Montpellier, France; Cardon, *Mémoires*, 222–23.

11. Cardon, *Mémoires*, 358, table 12.

12. Ibid., 356, table 10.

13. Jean Hellot, *L'Art de la teinture des laines et des étoffes de laine en grand et petit teint* (Paris: Vve Pissot, 1750), 320.

14. Document 3J 342, 1751, Archives départementales de l'Aude, Carcassonne, France; Cardon, *Mémoires*, 253–54.

CAPTIONS

a. Sidney M. Edelstein, "How Napoleon Aided the Early Dyeing Industry of France," *Historical Notes on the Wet-Processing Industry*, revised ed. (New York: Dexter Chemical Corporation, 1972), 17–18.

CHAPTER 17 (VÁZQUEZ/SECO)

1. Pedro Manuel Berges Soriano, "Museo del Pueblo Español," *Anales del Museo Nacional de Antropología* 3 (1996): 65–88. The show, sponsored by the duchess of Parcent, was organized by a large group of intellectuals, political figures, and artists. On display were some three hundred complete outfits, almost four thousand individual items, more than six hundred photographs, and hundreds of watercolors. In the inaugural address, the count of Romanones presented the idea of turning the show into a permanent museum of costume. In 1930 the museum was established in the Godoy Palace on the Plaza de la Marina Española. Four years later it became part of the Museum of the Spanish People, an ethnological museum conceived with a broader vision. Under the leadership of Luis de Hoyos, items

were acquired from all regions of Spain. But because of the Spanish Civil War, the Museum of the Spanish People was not able to open. Except for a couple of brief periods, the collections were packed up and stored until 2004, when the Museo del Traje finally opened.

2. *Exhibition of Regional Dress.*

Guide. 2nd ed. (Madrid: Artes de la Ilustración, 1925), 62–63: "The first display case on the left, seen from the back of the hall, contains the collection of Mrs. Guiú, also of Barcelona, the majority of it is on display in spite of the lack of space with which we struggled trying to install the largest possible number of items. This collection is of great importance and besides the pieces shown, being mainly the dress of ladies and gentlemen of the 18th and 19th centuries, it contains a series of small objects that complement the rich wardrobe of the nobility of that time." The complete catalog of the exhibition promised in this brief guide was never published; we have only the information gathered in this small book with no illustrations.

3. Thanks to curator Silvia Ventosa, we know that the Museo del Disseny de Barcelona has a total of twenty-one fabrics, almost all of silk and dating from the fourteenth to the nineteenth centuries, acquired from Don Francisco Guiú in 1910.

4. The original linen lining was partially restored at some point in the nineteenth century using a cotton taffeta with a design applied with a roller.

CHAPTER 18 (HEDLUND)

ACKNOWLEDGMENTS

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Gavin, Glenna Dean, Cordelia Thomas Snow, Dana Bates, and Hosanna Eilert.

1. Joe Ben Wheat, *Blanket Weaving in the Southwest* (Tucson: University of Arizona Press, 2003), 131, 135; Joe Ben Wheat, "Documentary Basis for Material Changes and Design Styles in Navajo Blanket Weaving," in *Ethnographic Textiles of the Western Hemisphere, Proceedings of the Irene Emery Roundtable on Museum Textiles*, ed. Irene Emery and Patricia Fiske (Washington, DC: Textile Museum, 1977), 420–40.

2. Wheat, *Blanket Weaving*, 131, 135; Wheat, "Documentary Basis," 427.

3. Carmen Sáenz-Hernández, Joel Corrales-García, and Gildardo Aquino-Pérez, "Nopalitos, Mucilage, Fiber, and Cochineal," in *Cacti: Biology and Uses*, ed. Park S. Nobel (Berkeley: University of California Press, 2002), 211–34.

4. Ibid., 226–27.

5. Wade Sherbrooke, "Defense Behaviors of a Cactus Scale and a Predatory Caterpillar: The Role of Cochineal in Multiple Defense Systems," unpublished manuscript, 1982, cited with permission of the author.

6. Cordelia Thomas Snow and Glenna Dean, "Out on a Limb: Cochineal Production in Spanish Colonial New Mexico?" in *Threads, Tints, and Edification: Papers in Honor of Glenna Dean*, ed. Emily J. Brown, Karen Armstrong, David M. Brugge, and Carol J. Condi, *Papers of the Archaeological Society of New Mexico*, vol. 36 (Albuquerque: Archaeological Society of New Mexico, 2010), 160; Richard Felger, personal communication, 2014.

7. Cordelia Thomas Snow and Glenna Dean note one contemporary Hispanic New Mexican *santero*, or saint maker, known to have harvested wild cochineal in Santa Fe and used it in his paint; Snow and Dean, "Out on a Limb," 162.

8. See Kate Peck Kent, "Archaeological Clues to Early Historic Navajo and Pueblo Weaving," *Plateau* 39 (1966): 40–51, and Wheat, "Documentary Basis," 428, for their first assertions; see Kate Peck Kent, *Navajo Weaving: Three Centuries of Change* (Santa Fe, NM: School of American Research Press, 1985), 44, and Wheat, *Blanket Weaving*, 62, for their amendment.

- The quotation is from Kent, *Navajo Weaving*, 44. In Casey Reed and Duane Anderson's article "Making Old Navajo Textiles Talk," *Tribal Art* 32 (2003), the authors assert that they identified Navajo-applied cochineal dye on native hand-spun wool, but their claim rests on whether the material tested was locally sourced hand-spun wool or recorded, respun fiber taken from red trade cloth. Analytical evidence suggests the latter to be more likely in all known cases.
9. Ward Alan Minge, "Efectos del País: A History of Weaving along the Río Grande," in *Spanish Textile Tradition of New Mexico and Colorado*, ed. Nora Fisher (Santa Fe, NM: Museum of International Folk Art, 1979), 8–28.
 10. Dorothy Boyd Bowen and Trish Spillman, "Natural and Synthetic Dyes," in *Spanish Textile Tradition of New Mexico and Colorado*, ed. Nora Fisher (Santa Fe, NM: Museum of International Folk Art, 1979), 207–11.
 11. Wheat, *Blanket Weaving*, 62, referencing the microfilm edition of the Mexican Archives of New Mexico, roll 6:463, State of New Mexico Records Center, Santa Fe.
 12. Minge, "Efectos del País," 19, note 71; Joe Ben Wheat, "A Glossary of Spanish Trade Terms: Cloth and Related Items Compiled from Early Trade Documents and Other Sources," unpublished manuscript, 1995.
 13. Josie Caruso, personal communication, 2014.
 14. Cf. Wheat, *Blanket Weaving*, 62.
 15. Washington Matthews, "Navajo Dye Stuffs," *Smithsonian Annual Report for 1891* (Washington, DC: U.S. Government Printing Office, 1893), 613–16; Charles Amsden, *Navaho Weaving: Its Technic and History* (Santa Ana, CA: Fine Arts Press, 1934), 93; Ulysses S. Hollister, *The Navajo and His Blanket* (Denver, 1903), 103; George H. Pepper, "Native Navajo Dyes," *Papoose* 1, no. 3 (1903): 3–12; H. P. Mera, *Navajo Textile Arts* (Santa Fe, NM: Laboratory of Anthropology, 1948), 10.
 16. Nora Fisher, "Introductory Remarks," in *Spanish Textile Tradition*, 212–14; Bowen and Spillman, "Natural and Synthetic Dyes," 209.
 17. Lowe Art Museum, 60.220.032. For illustration, see Fisher, "Introductory Remarks," plate 22. For analysis and illustration, see "Joe Ben Wheat Southwest Textile Database," Arizona State Museum, 2014, http://www.statemuseum.arizona.edu/coll/textile/jbw_southwest_textile_database.
 18. Dorothy Boyd Bowen, "Saltillo Design Elements," in *Spanish Textile Tradition*, 97, figure 7.
 19. David A. Wenger, "Appendix E: Dye Analysis," in *Blanket Weaving*, 359–69, figure E.3.
 20. Edward Bancroft, *Experimental Researches Concerning the Philosophy of Permanent Colors* (Philadelphia, 1814), 2:13, cited in Rita Adrosko, *Natural Dyes and Home Dyeing* (New York: Dover, 1968), 28. In *Blanket Weaving*, page 62, Wheat notes that pure lac appears most often in fine, S-spun yarns raveled from worsted fabric and generally suggests a pre-1865 manufacture. Because of contrasting domains of the British Empire and the Spanish colonial world, one might wonder if lac-dyed fabrics were primarily of British origin and cochineal-dyed fabrics were more often Spanish-made, but this idea has not been confirmed in the extant literature and is open to further research. Harold Colton, "The Anatomy of the Female American Lac Insect, *Tachardiella Larrea*," *Museum of Northern Arizona Bulletin* 21 (1944).
 21. "Joe Ben Wheat Southwest Textile Database"; numerical designations represent ID numbers of textiles described in the database.
 22. Helmut Schweppe and Heinz Roosen-Runge, "Carmine: Cochineal Carmine and Kermes Carmine," in *Artists' Pigments: A Handbook of Their History and Characteristics*, ed. Robert L. Feller (Washington, DC: National Gallery of Art, 1986), 255–83, cited in Snow and Dean, "Out on a Limb," 161.
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 25. For eight textiles at the Art Institute of Chicago, see Federica Possi, Lauren K. Chang, and Francesca Casadio, *Surface-Enhanced Raman Spectroscopy (SERS) as a Viable Alternative Technique for Dye Analysis: Application to the Study of Navajo Blankets from the Art Institute of Chicago Collection* (Paris: International Council of Museums, forthcoming). For the Southwest Museum's textile collection, see Kathleen Whitaker, *Common Threads: Pueblo and Navajo Textiles in the Southwest Museum* (Los Angeles: Southwest Museum, 1998) and Kathleen Whitaker, *Southwest Textiles: Weavings of the Pueblo and Navajo* (Los Angeles: Southwest Museum, 2002). For selected specimens from the Textile Museum, see Ann Hedlund, "Wool Yarns in Late Classic Navajo Blankets," *American Indian Art Magazine* 28, no. 4 (2003): 78–85, 92.
 26. Wheat, *Blanket Weaving*, 73, 85.
 27. Jessica Hemming, "Appropriated Threads: The Unpicking and Re-weaving of Imported Textiles," *Silk Roads, Other Roads: Textile Society of America Eighth Biennial Symposium* (Northampton, MA: Smith College, 2002) describes weavers from Indonesia, Nigeria, and New Zealand who "appropriate" yarns from previously woven cloths, highlighting the economic necessity and aesthetic "inclinations" that prompt these actions.
 28. For background history and details of the research, see Wheat, *Blanket Weaving*. For a summary of these traits and their time ranges, see Ann Hedlund, *Beyond the Loom: Keys to Identifying Early Southwestern Weaving* (Boulder, CO: Johnson Books, 1997) and Hedlund, "Wool Yarns."
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 30. Mera, *Navajo Textile Arts*, 69–74; Wheat, *Blanket Weaving*, 87; "Joe Ben Wheat Southwest Textile Database," textile ID 46, 822; Peabody Museum of Archaeology and Ethnology, 985-27-10/58892; "Joe Ben Wheat Southwest Textile Database," textile ID 1326.

CHAPTER 19 (BOL)

1. James A. Hanson, *Little Chief's Gatherings: The Smithsonian Institution's G. K. Warren 1855–1856 Plains Indian Collection and the New York State Library's 1855–1857 Warren Expeditions Journals* (Crawford, NE: Fur Press, 1996), 4–5, 15.
 2. George Catlin, *Letters and Notes on the Manners, Customs, and Conditions of the North American Indians. Written during Eight Years' Travel (1837–1839) amongst the Wildest Tribes of Indians in North America* (New York: Dover Publications, 1973), 1:209.
 3. Although broadcloth was produced in other areas of England, cloth from Stroud was noted for its beautiful colors.
 4. Lists were also made in gray and black.
 5. Don C. Clowser, *Dakota Indian Treaties: From Nomad to Reservation* (Deadwood, SD: Don C. Clowser, 1974), 121–22.
 6. Blue stroud cloth, dyed with indigo, was more universally used by Plains Indians.
 7. Ronald P. Koch, *Dress Clothing of the Plains Indians* (Norman: University of Oklahoma Press, 1977), 23–26.
 8. Ella Cara Deloria, *Dakota Autobiographies* (Philadelphia: American Philosophical Society, circa 1937), 81.
 9. James R. Walker, "The Sun Dance and Other Ceremonies of the Oglala Division of the Teton Dakota," *Anthropological Papers of the American Museum of Natural History* 16 (1917): 71.
- CAPTIONS
- a. Wetherill papers 1762–1899, CD 3479.P5H8, Library of Congress, Washington, D.C.
 - b. Elena Phipps, *Cochineal Red: The Art History of a Color* (New Haven, CT: Yale University Press, 2010), 36–37.

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INTRODUCTORY IMAGES

Case Ceremonial mantle, Bolivia, Aymara, eighteenth–nineteenth century. Camelid hair, 77¼ x 41 in. Metropolitan Museum of Art, bequest of John B. Elliott, 1997 (1999.47.251). © The Metropolitan Museum of Art. Image source: Art Resource, NY.

End pages Pages 45–46 of anonymous manuscript *Mémoires de teinture*, ca. 1763. Photo: Dominique Cardon/Pierre-Norman Granier.

Page 1 Detail of sarape, Saltillo region, Mexico, ca. 1750–1800. Wool, cotton, 93 x 63 in. Museum of International Folk Art, IFAF Collection, gift of the Fred Harvey Collection, FA.1979.64.101.

Page 2 Orlando Dugi, evening gown (from the Red Collection), Santa Fe, New Mexico, 2014. Hand-dyed silk duchesse satin, silk organza, and silk thread; cut glass and sterling silver beads, French coil, Swarovski crystals, vintage beads and crystals; lining of duchesse satin and tulle, 63 x 52 in. Collection of the artist.

Page 4 Farmers harvesting *Dactylopius coccus* (cochineal) from *Opuntia cochenillifera* cactus and roasting and drying the insects to prepare carmine dye, Mexico, ca. 1800. Hand-colored copperplate engraving from Bertuch's *Bilderbuch für Kinder* (*Picture Book for Children*), Weimar, Germany, 1807. Photo: SSPL/Science Museum/Art Resource, NY.