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Of Salt Men and Cloth: The Remarkable Textile History Preserved in Eurasian Salt-beds

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Of Salt Men and Cloth:
The Remarkable Textile History Preserved in Eurasian Salt-beds

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Dedicated to the memory of Irene Good

A B S T R A C T

Ancient colored textiles are seldom preserved by anything except salt or permafrost. Recent discoveries in collapsed areas of a salt mine in NW Iran have prompted this very brief comparison of the new finds, including their dyes, to the other two major Eurasian groups of salt-bed textiles.[1]

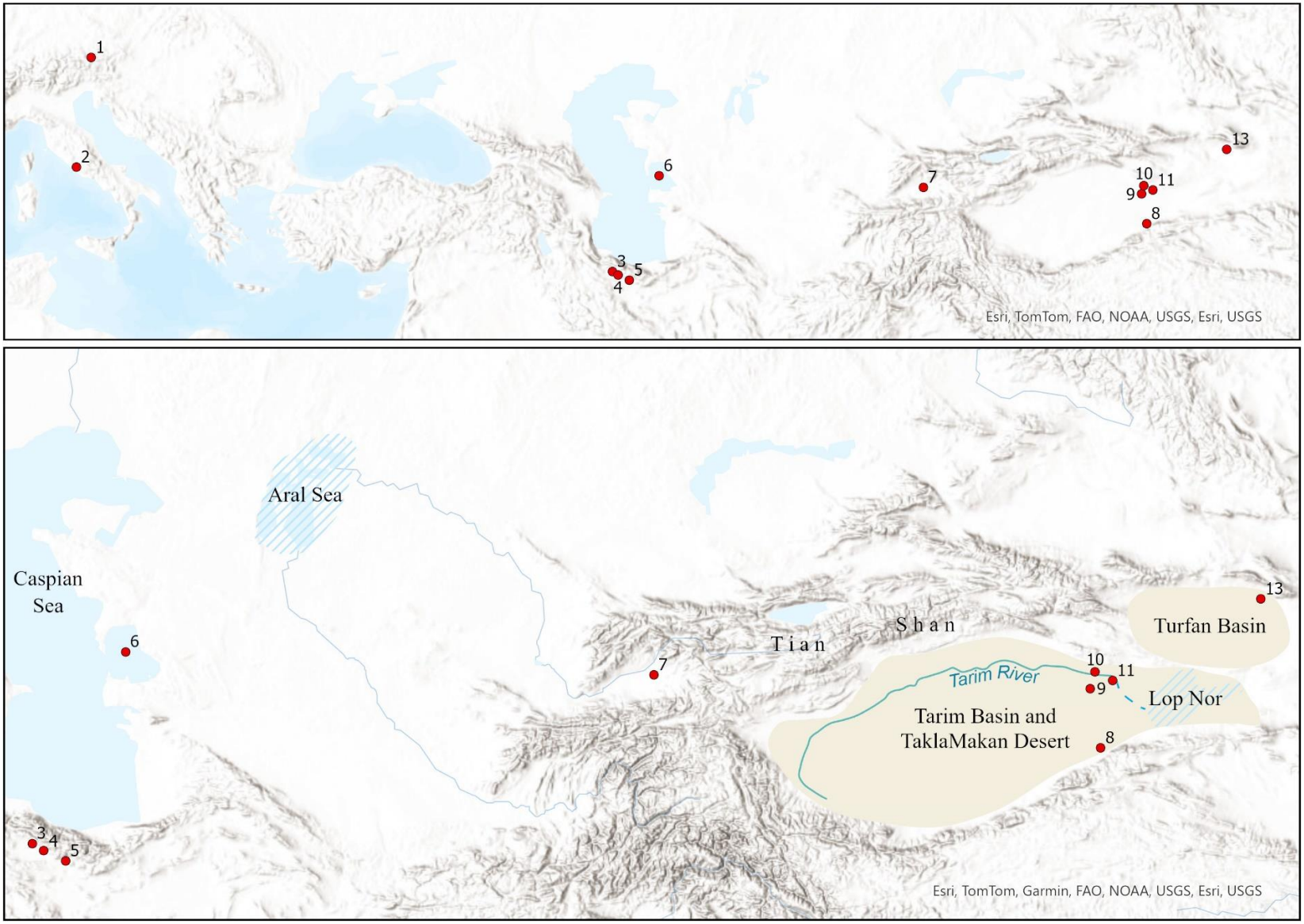
1 My warmest thanks to Victor Mair and Richard Laursen for prompting me to set together these major finds of salt-bed textiles, for helping me obtain literature and photographs of the recently found Iranian group, and for touching up my manuscript for greater accuracy.

1. PRESERVATION

The ancient textiles we archaeologists usually dig up are rather disappointing to look at, for most soils quickly destroy all color and most of the fibers too. The alkaline lake waters of Central Europe may preserve plant fibers, but they destroy woolen cloth entirely; and the acidic bogs of Northern Europe preserve wool and hair but destroy all plant fiber. There is even one Early Bronze Age piece, from Unterteutschenthal in north-central Germany (Schlabow 1959, 118–19 and pl. 17), in which the woolen weft(?) is preserved, undulating over and under empty air, since the plant fiber warp(?) is entirely gone but left its crimp behind. Both acid and alkali destroy the color, rendering the fragments a uniform brown, whether dark or light. So, unless any original patterning is discernable in the *structure* of the weave, we know little of what designs might once have graced these cloths, and nothing at all about color.

Salt, on the other hand, preserves both animal and vegetal fibers *and* their colors, giving us a far better idea of what ancient textiles—and ancient clothing—really looked like. When I began studying the development of ancient cloth and clothing half a century ago, everyone told me that people didn't use color in textiles until the end of the Bronze Age, because scholars knew that in ancient Egypt, where clothing survives in quantity thanks to extreme aridity, people just wore plain white linen until rather late. But, as I gradually figured out, the Egyptians wore plain white because Egypt is so dusty and these ancient people prided themselves on washing their clothes constantly. When they wanted color, it was far more effective (and permanent) to bedeck themselves with their famous jewelry of blue faience and colored stones, shining atop their clean white linens.

It turned out, however, that everyone to the north and east of them was actually busy weaving colorfully patterned fabrics of wool to wear, from the Stone Age on, and by the Iron Age busy passing cloth and techniques around. This trade is easiest to see when we are lucky enough to find textiles buried in salt. At the moment, there are three major areas scattered across temperate Eurasia whence we have such finds: salt mines in the Austrian Alps, salt-bed cemeteries in the Uyghur Autonomous Region, and salt mines in northwestern Iran (see Map).



Maps of the three Eurasian salt areas discussed. (**Above**) The three clusters, from the European Alps to the Turfan Basin of Central Asia. (**Below**) Greater detail of Iranian and Uyghur salt areas. **Alphabetic key to places discussed:** Chehrābād (3), Cherchen/Qiemo (8), Eylatan/Ailatan (7), Hallein (1), Hallstatt (1), Hami/Qomul (13), Kara Boghaz Gol (6), Loulan (11), Qäwrighul (10), Qizilchoqa (13), Rome (2), Tehran (5), Xiaohe (9), Zaghunluq (8), Zanjan (4). **Numeric key:** (1) Hallstatt and Hallein, (2) Rome, (3) Chehrābād, (4) Zanjan, (5) Tehran, (6) Kara Boghaz Gol, (7) Eylatan/Ailatan, (8) Cherchen/Qiemo and Zaghunluq, (9) Xiaohe, (10) Qäwrighul, (11) Loulan, (13) Hami/Qomul and Qizilchoqa. Digitized by Brian Maxwell.

2. HALLSTATT AND HALLEIN SALT MINES

The first group to receive some analysis came from the salt mines at Hallstatt and Hallein in the Austrian Alps above Salzburg (literally, "salt city," in German). *Hall-* was an old Celtic root meaning "salt," and the early salt miners there were indeed Celts, working these mines from about 1300 BCE until they migrated west during Roman times. During most of that period, they hacked the salt out of their mine tunnels as rock-salt and hauled it out in backpacks, leaving fragments of cloth, clothing, tools, and occasional bodies here and there in the maze as they worked (see Barber 1991, 186–95, for cloth overview). Around 400 BCE, shortly before they left, they learned to flush the salt out as brine, and so ceased leaving cloth fragments behind. A few textile pieces, especially from Hallein, show red and/or blue wool thread woven or embroidered onto white cloth (e.g., scrap #18: Hundt 1961, 19 and pl. 7.2–3). One of their favorite kinds of cloth, however, was plaid 2/2 twills, woven from long-wearing combed (not carded) yarns of brown wool combined with either green or yellow dyed wool (Fig. 1), suggesting that the famous Celtic plaid twills were originally invented to provide camouflage while hunting, during summer or fall respectively. Although the Scottish tartan *system* is relatively recent, Scottish families still have traditional "hunting" tartans in which green predominates. (Twill weave itself had been invented in response to the advent of usable wool, roughly 3500–3000 BCE, since wool has quite different properties from plant fiber.)

Fig. 1. Reweaving of green and brown plaid 2/2 twill from salt mines at Hallstatt, Austria; first half of first millennium BCE. Brown is natural wool, green originally produced from yellow dye with iron mordant on white wool. (Thread by thread replica by author; author's photo).

3. TARIM AND TURFAN SALT BASINS

The second group to receive study was that of the numerous ancient textiles from the Tarim and Turfan basins, in the middle of that Central Asian corridor between China and the west that is now nicknamed the Silk Road. (See Barber 1999 for an early overview of textiles there.) In this case, the textiles come not from salt mines but from burials in salt beds. The Tarim Basin is formed by a huge tectonic block being pushed downward as the Indian continent slams into the Asian, forcing the Himalayas and Tian Shan to buckle upwards on either side of it. Before the collision, the area was already a great saltwater gulf, and, as its connections to the oceans disappeared, the trapped saltwater had no choice but to evaporate—titrate—leaving great salt beds behind. Since the basin now sits in a rain-shadow from the high mountains encircling it, the only water arrives as rivers of fresh glacial meltwater from the surrounding mountains, becoming saltier and saltier as it evaporates or sinks into the sands, much like the Caspian Sea and its landlocked "outlet," the Kara Boghaz Gol. The Tarim River once ended in a large brackish lake, the Lop Nor, at the east end of its basin, but overuse of this water by masses of recent

immigrants from China has essentially obliterated the Lop Nor—just as Russian immigrants have by now obliterated the landlocked Aral Sea east of the Caspian.

The ancient immigrants, on the other hand, recognized that there was relatively little arable land around, so to keep that available for growing crops, they generally buried their dead in the otherwise useless salt flats. Our gain! The salt has wonderfully preserved both the bodies (only occasionally further treated to achieve mummification) and also the clothing, as well as many other artifacts that usually perish. The best-preserved bodies appear to be those that were buried in the winter, so that they freeze-dried even as they were being pickled in salt.

The earliest group of clothed Tarim mummies that I have worked with date to the early second millennium BCE and were found in various cemeteries, mostly to the west of the ancient Loulan Station (as the Chinese came to call it, simplifying the syllables and shifting *r* to *l*: probably originally *Kroraina*). Here the ever-shifting Tarim River flows around the north edge of the vast Taklamakan Desert, changing its exact course sporadically when it floods and forcing people to move accordingly. The most famous of these mummies, nicknamed the Beauty of Loulan, came from a cemetery called Qäwrighul, marked by log circles (Barber 1999, 71–76). But many more burials from the same culture and roughly the same date have been found recently in a huge mound of salty sand and sand-stabilizing logs near the so-called Small River (Xiaohe). In this culture, fiber-based clothing was created entirely from sheep's wool (either felted directly or woven and often felted as well), with ornamentation generally achieved from sorting the wool by its natural colors—everything from cream through tan and golden brown to a very dark chocolate brown (Fig. 2).

Fig. 2. Head of eight-year-old child wrapped in woven blanket, buried at Qäwrighul, northern Tarim Basin, Uyghur Autonomous Region; ca. 1800 BCE. All these patterns were created from natural wools sorted into dark brown, tan, and cream. (Author's photo 1995.)

The effects these people created from just the natural colors were often quite remarkable (see also Mair 2010, #61, for the Beauty of Xiaohe; #64 for a striped cloak), but occasionally we find threads dyed red or blue. Some of the yarns braided together to tie the Beauty of Loulan's felted cap onto her head include red and blue (Barber 1999, diagram fig. 4.2). And several of the yarns found on dolls' clothes and other artifacts from the Xiaohe site were dyed bright red (Mair 2010, e.g., #49, 53, 56, 58, 59). All the prehistoric reds tested from this area, so far as I know, have turned out to be from madder (*Rubia tinctorum*), while the blue is necessarily a form of indigotin, probably from woad (see below). Clearly people were experimenting—a few precious threads at a time—with possible dyes, many of which require mordants to make the color permanent. I suspect, in fact, that the thicker, paler threads woven partway into the front of the blanket-wrap of another mummified woman from Qäwrighul are the remains of once-bright and ornamental threads that failed to retain their color (Fig. 3).

Fig. 3. Top corner of woman's wool blanket-wrap, showing what is evidently the starting border plus several paler and thicker supplementary threads, petering out here and there, that were probably originally colored and thus provided simple ornamentation down her front. From Qäwrighul, Tarim Basin, ca. 1800 BCE. (Author's photo 1995.)

The next group, a thousand years later, comes from the salty sands of Zaghunluq, close to the current town of Cherchen (Chärchän), on the southeast edge of the Taklamakan. But now *everything* is dyed, and men, women, and children have all become the proverbial "peacocks and popinjays" with lavish use of red, yellow, and blue dyes on their woolen outfits. Some garments sport a single color while others had colorful embellishments woven in, or somehow sewn, felted, or painted on. About the only thing they had not figured out is double-dyeing—say, to create green by dyeing blue on top of yellow. (The Hallstatt green is actually the result of yellow plant-dye fixed with iron mordant.) But they cleverly created a wonderful effect by dyeing brown wool with red dye, which (as with a woman who treats her brown hair with henna) appears to shift its color from dark red to purple to brown and back again, depending on the angle from which you look at it (Fig. 4, baby's blanket).

Fig. 4. Baby with bonnet of gently felted blue and red wool, wrapped in blanket woven of brown wool dyed with red (giving variable purplish hue) and tied with red and blue twisted cords. Blue stones cover the eyes; wisps of red wool stop up the nostrils. From Zaghunluq, near Cherchen, southern Tarim Basin, ca. 800 BCE. (Author's photo 1995.)

Textile techniques included felting (both fiber-felt and woven felt), plain weave (often weft-faced), brocade (Fig. 5), simple pile, multi-strand plaiting (both flat and cord-like), and overspinning for texture stripes, as well as designs applied with paint (Barber 1999, chap. 1–3).

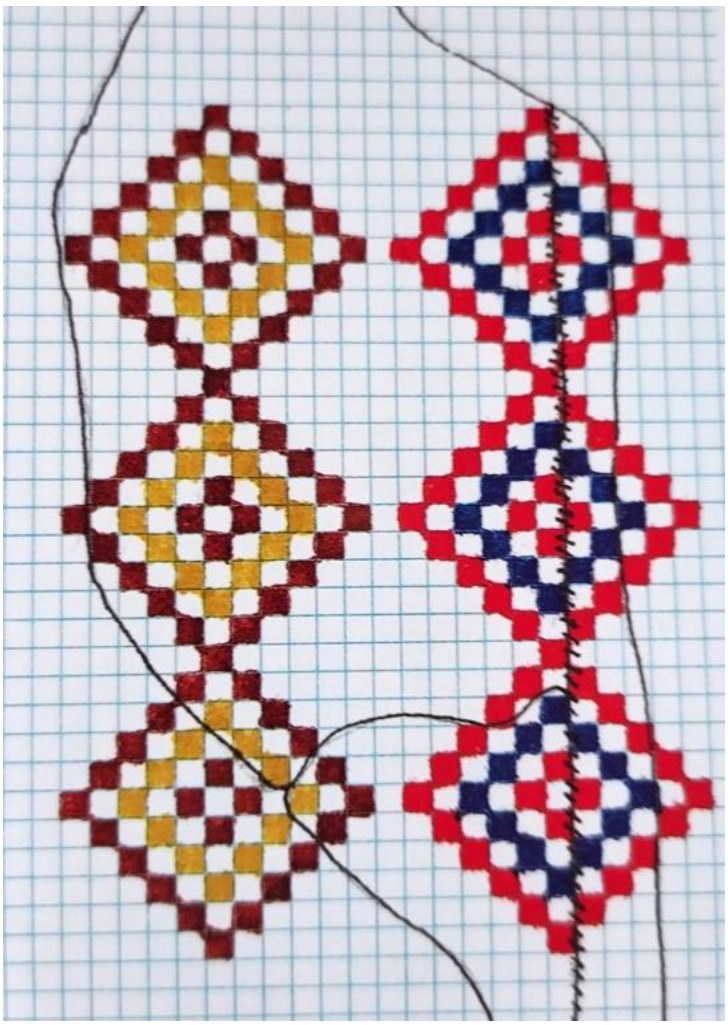


Fig. 5. Fragment of tabby-woven white wool, brocaded with rows of concentric lozenge figures. A seam line runs through the red and blue set, joining two selvedges woven to match up. Black line indicates edges of scrap. Zaghunluq, near Cherchen, ca. 800–500 BCE. (Author's drawing.)

They also used, perhaps even invented, a form of twill weave in which the weft hops over not just one or two threads at a time (as in 2/1 and 2/2 twills), but many, even as many as five. This "long-hop" weft was then packed down hard to form a very thick, weatherproof cloth, for example, for a heavy overcoat that survived (where wefts regularly hop over 3 then under 2). And when they encountered the notion that one could make tapestry-type designs, they used *this* weave (quite unlike the traditional Near Eastern method) to cover the warp with the colored tapestry wefts (Fig. 6).

Fig. 6. Tapestry band on shirt sleeve. Whole shirt is woven in "long-hop" twill, with wefts crossing several warps before binding. (Note that the apparent diagonal of the threads is not even close to a 90-degree slant, as in 2/2 twill.) From Zaghunluq, near Cherchen, southern Tarim Basin, 800–500 BCE. (Photo Irene Good.)

Also from the first half of the last millennium BCE comes a group of colored textiles of wool from burials in the Turfan Basin, just northeast of the Tarim, at a site called Qizilchoqa, near the modern town of Hami (Qomul). Some of these cloths have amazed and intrigued Westerners by being plaids—that is, by sporting color stripes of *uneven* width in both warp and weft. (Crossing stripes of the *same* width, a common pattern, produces a checkerboard, which occurs here too; but "plaids" are quite rare, worldwide.) Of what I saw, some plaids were in plain weave with red and blue stripes on white, while others were woven in 2/2 twill with darker colors (Fig. 7, 8).

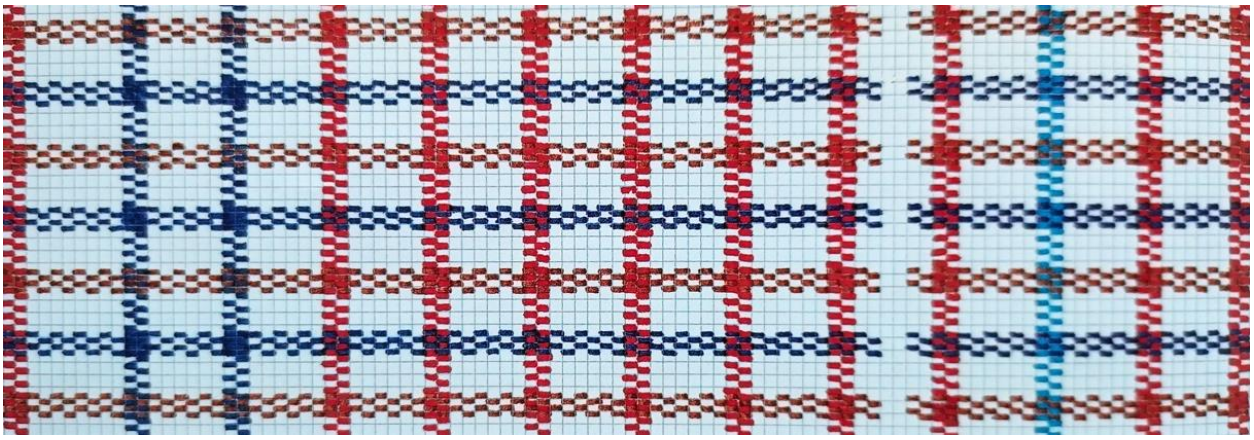


Fig. 7. Red and two colors of blue forming plaid stripes on plain-weave white wool cloth. (Gap represented many repetitions of red stripe.) From Qizilchoqa burial ground near Hami, Turfan Basin, Uyghur Autonomous Region; ca. 1000–700 BCE. (Author's drawing.)

Fig. 8. Reweaving of five-color plaid twill from Qizilchoqa burial ground near Hami, Turfan Basin; ca. 1000–700 BCE. (Thread by thread replica by B. Ashenden, using brown warp and dark red weft to mimic purply-brown color originally created by red dye on brown wool. Author's photo.)

Despite what keeps bobbing up in the popular press, these plaid twills were not brought to Central Asia by Celts (who persistently headed west, not east), but by other Indo-Europeans carrying the same weaving technology—most likely Iranians. We know the Iranians not only migrated east from the Indo-European homeland around the western Caucasus, but also herded their livestock all the way to China and perhaps the Pacific, leaving behind vocabulary and technologies along the way. We do not have their early cloth preserved in salt, so we haven't the evidence to prove that it included plaid coloring, but we do know that prehistoric people, probably Iranians, were making 2/2 twill cloth in the Fergana Valley, since we have impressions of this weave-type on their pottery from several sites in the early-mid first millennium BCE (especially clear at the site of Eylatan, a.k.a. Ailatan, near Andizhan: Zadneprovskiy 1962, photos in plates LXIV–LXVI).

From then on in the Tarim area, and right up to the present, we find masses of remarkably preserved textiles in the salt-bed burials. Since all the textiles from the prehistoric period have turned out to be wool, I will only mention that, by the turn of the era, we have not just woolens but also wonderful silks preserved, initially from China but eventually locally made as well.[2]

4. CHEHRĀBĀD SALT MINES

In the winter of 1993–1994, miners in the Chehrābād salt works came across a man's body that had been deliberately buried in the middle of a mine tunnel 45 m (148 ft) long, along with a fair number of possessions. These mines, known as Douzlākh (Salty Ground), are located in hills facing the Chehrābād River near the villages of Hamzehlu and Chehrābād, west of Zanjan in northwest Iran (Fig. 9). This ancient man had long, well-preserved hair, beard, and mustache (all bleached pale by the surrounding chemicals), as well as objects of leather, iron, silver, pottery, stone, and cloth—including part of a pair

2 Few are aware that silk finds in Europe predate by centuries the linking up of trade between Han China and the Romans (in which multicolored Roman glass was as highly prized as Chinese silk—but harder to transport). Some of these silks come from local species of moths, but others, with a round cross-section, are from Chinese *Bombyx mori.* Particularly interesting are the six pieces of silk found in the tomb of a relative of the Greek *enfant terrible*, Alcibiades, from the late fifth century BCE. See Barber 1991, 30–32, for various finds of early silk in Europe. Much has been found and/or (re)analyzed since 1991, of course.

of trousers of wool with a decorated border, and three patterned textile fragments. Radiocarbon dating placed him around 300 CE, early in the Sassanid era, while other tests indicated he was about thirty-seven years old, 175 cm tall (5 ft., 10 in.), and of blood type B positive. CT scans showed that just before death he received a hard blow that damaged his skull, including fracturing the area around his eye. He also wore on his left ear a round gold earring, which, together with all the artifacts buried with him, suggested that he ranked well above the usual miner. His remains and belongings now reside in the National Museum in Tehran.

Fig. 9. View of Douzlākh salt mines at Chehrābād, near Zanjan, NW Iran, with tamarisks in foreground. (Photo Richard Laursen)

Over the next two decades, the Chehrābād mines gave up more bodies from the salt. In late 2004, miners bulldozed into another crushed body (#2), causing archaeologists to come for a rescue excavation. This man, also Sassanian, dated to about 500 CE. In 2005, the excavators—who were also

mapping the positions and extent of the ancient mine galleries—located three more male bodies in Trench A, along with some artifacts and masses of fallen salt-blocks. Bodies #3, #4, and #5, however, proved to be earlier, namely Achaemenid, indicating that a catastrophic collapse in the mine had occurred around 400 BCE.[3] All four bodies (#2–5) and their artifacts were taken to a newly founded archaeological museum at Zolfaghari House, in Zanjan (the regional capital), where they were analyzed and put on display. Body #2 turned out to be a middle-aged man about 180 cm tall, whereas #3 was too disintegrated to give much information.

Body #4, on the other hand, was the best preserved of all: a beardless boy of fifteen or sixteen, 170–175 cm tall, lying face down under a huge rockfall. (Confusingly, photos always show his body face up.) So much of his clothing survived that his outfit could be largely reconstructed: open-topped trousers covered by a long tunic with collar and ¾-length sleeves, plus leather moccasins (Fig. 10). He too sported a metal earring, wore his brown hair short, and was carrying a sheathed knife and two little round pottery jars. Body #5, though crushed and mostly skeletonized, was otherwise rather well preserved, along with bits of his skin and some of his clothes. An adult male, he was radiocarbon-dated to 550–380 BCE, the Achaemenid period. Excavating further in 2010, archaeologists uncovered yet another crushed and dismembered body of Sassanid date, #6, which they left *in situ* in the mine. By this time, mining operations had been suspended in favor of archaeology and the salt dome declared a cultural heritage site.

3 The relevant eras are dated thus: Achaemenid (550–330 BCE); Parthian or Arsacid (247 BCE – 224 CE); Sassanid (224–651 CE). The bodies we have all proved to be either Achaemenid or Sassanid, in each case victims of major cave-ins, although Arsacid (Parthian) pottery was found in one of the ancient galleries, and some rather later Safavid and modern artifacts elsewhere. Clearly this somewhat unstable salt deposit has been mined for at least 2500 years.

Fig. 10. Sketch of outfit worn by Saltman #4, the teenage boy: tunic-like shirt, ankle-length trousers, and leather moccasins. Note heavy lines at the sleeve ends, denoting bright red threads rimming them. (After reconstruction by Aleksei Moskvin *et al.* 2019.)

In all, it seems that six bodies and pieces of at least two more (mixed with #1 and #3 and now labeled #7 and #8 respectively) were found in the salt-beds between 1993 and 2010, some by miners, some by archaeological excavators. Of the bodies, the best preserved was the teenage boy (#4, on display now in Zanjan); the rest were grown men. (Careful forensic examinations have not substantiated some early reports of a female body.) All these people appear to have died from cave-ins in the mines. Along with the bodies were found various artifacts, including over one thousand (bits and) pieces of cloth, some plain and others still showing colors and patterns.

5. CHEHRĀBĀD TEXTILES

Much of the cloth is plain, almost entirely of wool (though cotton is mentioned once: Nik, no date, 19). By now a fairly uniform tan, most of it is plain weave (tabby), often with fine weft hard packed on a thick warp. Such, for example, is the cloth in the outfit of the teenage boy, in which the fabric around his hips can be seen to have a strongly corded appearance, thick warp thread having been used to give him a sturdy shirt (Fig. 11).

Fig. 11. Detail of corded-looking shirt fabric near waist of Saltman #4. (Photo Daniel Waugh.)

Karina Grömer, an expert in the Hallstatt textiles who was brought in to help analyze these finds, summarizes the early group as follows:

> The most impressive textiles from the Achaemenid period (fifth/fourth centuries BC) are the more or less complete garments associated with salt man 3, 4 and 5 (e.g. Aali & Stöllner 2015, fig. 56; Grömer & Aali 2016). Among the other textile fragments found in Achaemenid layers are some textiles in tabby and its variants. There are also textiles with various patterning techniques such as stripes and textiles with weft-floating patterning. Remarkable among the Achaemenid textiles are the marks of repair. (Grömer and Bagherpour 2018, 110)

Descriptions of the pieces at the time of excavation also indicate that the embellishments on the textiles fall into two categories, woven and sewn, the latter being mentioned often on the clothing, sometimes along the seam lines. Clearly people liked to ornament their clothes, however subtly: the sleeves of the boy's shirt (#4), for example, end with a thin line of red wool. The design on one early piece, however, I found particularly interesting because of its possible connections elsewhere: a tan wool fragment decorated with lozenge patterns formed from little squares (Fig. 12).

Fig. 12. Achaemenid-era cloth with lozenge-shaped pattern brocaded or embroidered in dark brown on pale plain-weave wool. Additional small squares done in lighter colors are just visible to lower left; shadows of former embellishments are also just visible between the lines of brown squares. Mounted in museum so that heavier threads, presumed warp, stretch horizontally, and weft vertically. (Photo Daniel Waugh.)

The basic cloth is plain weave (tabby), heavy tan threads in one direction (warp?) crossing rather thinner and lighter-colored threads (weft?) the other way. The best-preserved section of the pattern presents a lozenge concentric to a larger lattice pattern. The lines forming all these patterns are made up of parallel rows of tiny squares sitting corner to corner: 3 rows for the lattice, 2 rows for the internal lozenge.

The little dark squares, in turn, are each made up of 3 heavy threads hopping in parallel over 3 of the heavy ground-threads and leaving 3 bare between squares. I cannot see the back, but looking through the holes in the cloth I see no evidence of the dark threads carrying over from one section of the lattice to the next. Hence, they must have been added either during the weaving as little supplementary wefts or afterwards as embroidery. (The fourth set of squares to the left of the crossing-point of the lattice clearly has 4 threads, not 3, an error that also appears in the lozenge above it, but not, it seems, in the lattice section below it.) Presumably this same pattern continued below, forming stacks of lozenges-within-lozenges.

Careful inspection of the partly-preserved lattice compartment to the lower left, however, shows a slightly different pattern. First, the internal component appears to have been a square or something else with a bump to upper right, not a lozenge. Between the lattice and the unknown figure in the lower left, we can make out two little golden-brown oblongs constructed with a pair of thicker threads hopping over the usual 3 warp threads, and to the left of them, almost to the dark figure, are 2 more silvery-gray threads hopping over the self-same 3 warp as the golden threads to their right and the dark threads to their left. So pattern threads of other colors also once existed on this textile. Slight stains and disturbances on the ground-cloth, running in the now-open path to the upper left of these surviving silvery and golden squares, suggest that there once existed a whole line of additional squares there, now disintegrated. There also appears to be a round depression between the surviving silvery and golden squares, as though some bigger figure had been sewn onto that spot. That said, one notices that the space around the complete lozenge also seems to have around it a band darkened by disturbance, as follows: band of squares, narrow light band, wider dark-shadow band, narrow light band, band of squares.

Careful analysis thus shows that this piece was highly decorated in three or more colors contrasting with the plain-weave base cloth and had much more added ornamentation than appears at first glance.

Consider, now, a piece that I analyzed and drew when working in Ürümchi on the textiles from the salt-bed burials of Zaghunluq, in the Tarim Basin (Fig. 5). These burials were dated to around 800–500 BCE and belonged to people who may well have been Iranian (although we have no contemporary inscriptions there to prove it, only migration patterns). On this fragment, too, we see concentric lozenges with sides composed of little squares, 3 threads wide, set corner to corner. If the outermost lozenge is red, so is the innermost, while the lozenge between them is a contrastive color, blue; when the outer and innermost are brown, the one between is different, namely tan. Similarly, the Chehrābād piece shows noticeable shadows of having had such "between-lozenges," necessarily differing in color from the preserved brown ones. It is just possible that those "shadows" preserve tiny bits of the original pattern-threads that could be teased out and analyzed for color. I have seen such a miracle performed before, with a 1000 BCE sash from Lefkandi, Greece.

Forensic and DNA analysis of the bodies from the Achaemenid period (550–330 BCE) has shown that this group of miners was not entirely local, some coming from the steppelands to the northeast. So questing for relationships in that direction is not uncalled for. Before the "Silk Road" came to be, there was a massive "Wool Road" from the Europe and the Near East all the way to the gates of China.[4]

The next group of miners, the Sassanians, proved to be entirely local, however. Dr. Grömer summarizes what she saw of their fabrics as follows:

> The main part of the dated textiles are from the Sassanid Period (third to sixth century AD). There is one complete upper garment and fragments of trousers (from salt man 2

4 See Aslan 2023 for a new (and sometimes hair-raising) account of that transcontinental "road," written by someone involved for many years in documenting and promoting the local textile industries along it. I am surprised, however, to have found no mention yet of felting among those miners whose DNA hails from the steppes. Perhaps they did not feel the need, this far south, of its extra warmth, so critical on the cold and windy steppes. Or perhaps the analysts simply have not noted it in the literature available to me.

> and one further find) described by Krug-Ochmann (2014). Among the patterned and dyed textiles (see also Mouri *et al.* 2014) we can find fragments decorated with tapestry techniques, striped items, some items made in compound-weave techniques (Hadian *et al.* 2012), and warp-based patterning. (Grömer and Bagherpour, 110–11)

I have found images hard to come by of *any* Chehrābād textiles, but the easiest-to-find-photographs-of on the internet are a warp-faced belt or sash with an attractively showy bar-pattern in red, blue, yellow, and white (Fig. 13), and a large blanket with red, blue, yellow, and gray-brown stripes on a white ground, both housed in Zanjan. This sash and a few other pieces provided samples for extensive dye analysis—something archaeologists very seldom get a chance at, and to which we now turn.

Fig. 13. End of a Sassanian-era sash, band-woven in several still-bright colors, found tied to another rather similar but different band. This end provided one of the fragments analyzed for dyes of red, yellow, and blue. (Photo Richard Laursen.)

6. SOME ANCIENT EURASIAN DYES

RED

Human brains are programmed to respond particularly strongly to the color red,[5] and the ancient dyers in northwestern Iran, too, were especially fond of it. Chemical analysis of several textiles of both the Achaemenid and Sassanian eras (including the multicolored sash) concluded that the bright red in use was always from madder, *Rubia tinctorum*, a plant widespread across Eurasia, Africa, and also the Americas to this day—I used to find my hands unexpectedly red when pulling weeds at a mountain cabin in California. (See Mouri *et al.* 2014 and Laursen 2019 for full chemical details on the Chehrābād dye analyses.) The same plant was responsible for the reds found in the Tarim salt-bed burials.

YELLOW

The source of the yellow dye, on the other hand, proved to be much harder to determine. Many, many plants will give nice yellow dyes, but this particular yellow dye turned out never to have been encountered by analysts before. After much work, Laursen and his team finally figured out that it may have come from tamarisk, which contains an unusual sulfonated yellow flavonol—and noticed that tamarisk bushes can be seen all over photographs of the outside of the Chehrābād mines! (See Fig. 9.) So, as with red, the dyers were using plants that were easy to find locally. With both red and yellow, the only discernable mordants—metal ions used to attach a dye more firmly to the cloth—were aluminum-based (Hadian *et al.* 2012).

GREEN

Before aniline and other chemical dyes were invented late in the nineteenth century, the color green

5 Research by Paul Kay and others (e.g., Kay *et al.* 2009) has established that all languages (examined so far) that have more than two true color words have a word that includes red. In languages with relatively few color words, the word containing red also contains other warm colors, such as yellow. Red tends to get its own term before yellow does, which in turn occurs before a term grouping green and blue breaks up into separate green and blue terms. Red, yellow, green, and blue: these are the four colors we have here.

generally could be created only by dyeing the cloth or yarn serially with yellow and blue, in either order. This turned out to be true of the green stripe bordering a strip with a foliage design on a Sassanian piece, the yellow having come from tamarisk and the blue from the same source as blue on other local fabrics. (Exceptions to this maxim are the dusky pea-greens created in northern Europe, from Hallstatt times—that is, the Iron Age—to the present, by mordanting common yellow plant dyes with iron by boiling everything in an iron pot.[6])

BLUE

Blue is another human favorite. As the team that analyzed these textile dyes put it, "The only natural blue dye is indigotin, which is produced by a number of plants." (Mouri *et al.* 2014, 3.) They explain that there are in fact three chemically related close cousins involved here: indigotin itself, indirubin (which gives a slightly purpler blue), and "pseudoindirubin," and these can sometimes be used to identify the plant source. (Indigoid dyes, like the chemically related sea-snail purples, need no mordant because they attach to fibers through oxidation. In fact, these liquids are colorless before oxidizing, and watching the color mysteriously appear is fascinating.) The chemicals received their names from the indigo plant (*Indigofera tinctoria*), which came to Europe about three millennia ago from—where else?—India.

Now, Europe already had a plant people commonly used for blue, namely woad (*Isatis tinctoria*), which carries much the same chemicals as indigo along with an etymology going back all the way to proto-Indo-European. The early Britons famously used this woad to paint their bodies blue when

6 Mordanting with iron was not possible, of course, *before* the Iron Age. In fact, broad access to iron, starting at the very end of the second millennium BCE, caused a number of important changes in textile technology, the most important, perhaps, being the invention of one-handed shears for shearing sheep. Bronze is not springy like iron, so iron was needed to obtain shears that would open automatically after each time the blades were pressed together to cut the wool loose, a design still in use. Since sheep, which had been bred increasingly for wool since perhaps 4000 BCE, were by 1000 BCE losing their original ability to molt their coats, the wool now *had* to be sheared off, not plucked or combed off as before. It would be interesting to know if the wool in the Achaemenid textiles had been plucked/combed or sheared off the sheep. The percentage of root-ends present should tell. See Barber 1991, 261–62, for the interesting semantic shifts of Indo-European words for how you get the wool off your sheep, shifts that reflect exactly this sequence.

fighting the Romans, and various bits of blue European textiles have been found to contain dye from woad, all the way back to the Neolithic (Barber 1991, 234). But woad contains smaller amounts of the dye than indigo does, such that indigo became a highly coveted object of trade, once it became known outside of India. The blue dyes on the analyzed textiles from Chehrābād, however, all turned out to come from woad, not indigo, since they all contained "pseudoindirubin," apparently the specific marker for woad (Mouri *et al.* 2014, 3–4).

Today when we think of indigo-blue, we think of the slightly grayish dark blue of our blue-jeans. But blue-jeans are made of cotton, and rug merchants assure me that indigoid dyes on wool, and especially on cashmere, give a much brighter blue, as in these samples. The same must be true for the knock-your-socks-off blue of the wool (cashmere?) forming the lightly-felted cap of the little baby found at Zaghunluq, in the Tarim Basin (Fig. 4). It, too, must have been dyed with woad. Woad in fact grows naturally not just in Europe but all across roughly-temperate Eurasia, clear to China. Might we call it the woad road? It even leads somewhere else of interest.

Sinologists have long wondered why the words for "blue" and "cabbage" in Chinese are homonyms: both 藍 *lán* in Mandarin. But just recently, perusing dye information about woad from Richard Laursen, Victor Mair noticed that woad is actually in the cabbage family, Brassicaceae (earlier called Cruciferae), and that rural people have long found ways to get blue coloring out of a number of types of cabbage (Mair 11/22/2023), especially the purple kind. Hence the unexpected homonyms. Thus, from all these textiles preserved in salt, we even have the solution of an interesting etymological conundrum.

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