

Recently excavated artifacts
from Pakistan have inspired
a reevaluation of one of the great
early urban cultures—the enigmatic
Indus Valley civilization

UNCOVERING THE KEYS TO THE LOST INDUS CITIES

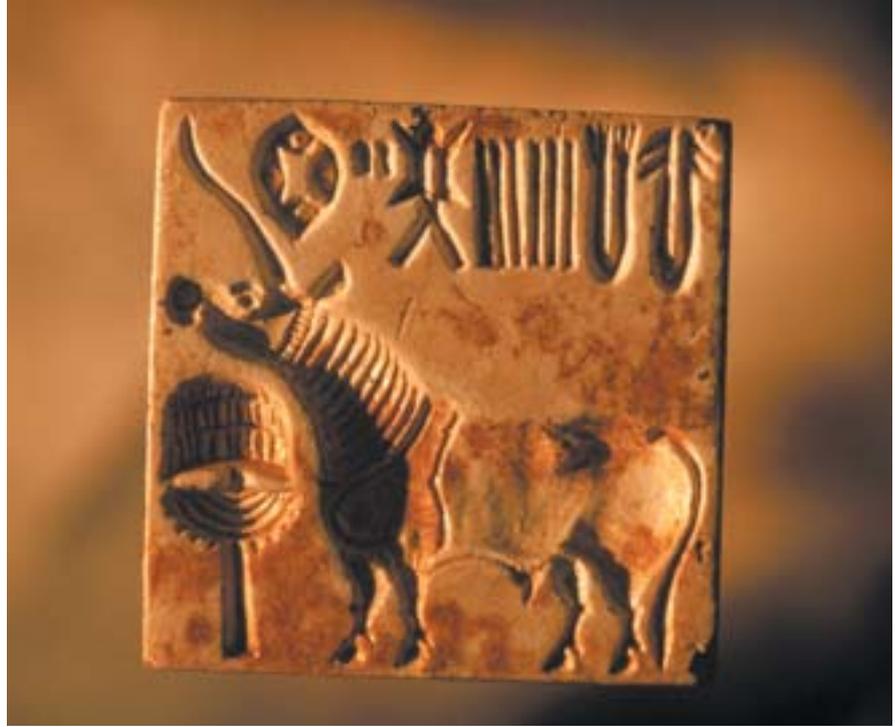
By Jonathan Mark Kenoyer

COLORFUL STONE BEADS such as those from Mohenjo Daro (*above*) were more than mere baubles for the ancient peoples of the Indus River Valley civilization; they served as symbols of wealth, status and power. Skilled artisans developed sophisticated craft technologies to fabricate these and other kinds of ornaments for the elite classes of this early urban society. Archaeologists interpret the strikingly carved soapstone figure, the so-called priest-king (*left*), to be a member of the Indus Valley ruling class.

In the mid-1980s, during our first few seasons excavating the long-dead city archaeologists call Harappa, my colleagues and I watched the passage of the annual spring fairs without realizing their implications for our studies of the ancient Indus civilization. Every year in Pakistan's Indus River Valley, people living in villages travel to larger towns to attend festivals called *sang*, "gathering fairs" where musicians, performers and circus troupes entertain the crowds while itinerant merchants and traders hawk their wares. During the single-day event, women present religious offerings to professional pilgrims, who, on the women's behalf, will later petition the Sufi saint Sakhi Sarwar for healthy children, especially sons. At day's end the holy sojourners and their colorful secular entourage make their way by foot and donkey cart to the next town along the region's age-old trade routes [see illustration on page 70].

Eventually various groups of devout wayfarers arriving from different parts of the country converge on the saint's tomb hundreds of kilometers away in the Baluchistan hills. Here they deliver the alms and prayers they have collected during their treks to the saint's precinct. Making their way along the same path the next year, the pilgrims bear salt and sacred earth from the distant shrine, tokens of favor for the fortunate mothers and their precious newborns.

Our view of the *sang* changed significantly when we began digging inside the southern gateway of Harappa, just adja-



INDUS MERCHANTS stamped glazed seals bearing animal images and the undeciphered Indus writing symbols into soft clay tags attached to trade goods to indicate ownership and accounting information.

cent to the traditional fairgrounds. As we sifted the uppermost soil from the newly opened trenches, we recovered modern pottery shards, hundreds of pieces of recently manufactured glass bangles, some contemporary coins, lead pellets from the air guns fired at balloons during the festival, fragments of plastic and metal toys, even a gold earring. Just below the surface levels, however, we began finding ancient Harappan artifacts that were surprisingly similar to the modern flotsam: broken pottery, terra-cotta bangles, clay marbles, toy carts, figurine fragments, and, occasionally, inscribed tablets and weights that were probably used in trade and taxation at the city's entrance.

The buried remains suggested that a thriving market existed in the vicinity

and that the activities conducted there some four millennia ago were not unlike those occurring even now. Our further work has confirmed that belief. As today, nearby villagers would come to the big city on special market or festival days to participate in ceremonies, to renew family or clan ties, or to buy (or barter for) specially crafted items such as ornaments and pottery. Along the very same pathways trod by present-day pilgrims and their followers, raw materials from the hinterlands once arrived at the gates of Harappa, where the artisans in the city's many workshops transformed them into the finished luxury products that were later purchased by local elite personages and shipped far afield for export markets. Then, as now, people in the Indus Valley wore ornaments and jewelry to demonstrate their wealth and status. To modern observers, the continuity of day-to-day life in this region from deep in the past to the present is rather astounding. As archaeologists, we can try to determine whether these similarities result from cultural choices or from the fact that the available materials and technologies have not changed much over the millennia.

The enigmatic Indus Valley civilization was one of the four great early Old World state-cultures, along with Mesopotamia, Egypt and China's Yellow River civilization. But much less is known about it because, unlike the other ancient

Overview/*Crafts as Cultural Clues*

- The ancient Indus Valley civilization, which first arose in what is now Pakistan and western India after 2600 B.C.E., is the least known of the four major early urban cultures in the Old World, which included Mesopotamia, Egypt and China.
- With no "Rosetta stone" to rely on, linguists have failed to decipher the ancient Indus writing, so researchers must study stone beads and other surviving evidence to try to understand the social, economic and political structure of this once extensive state.
- Through careful investigation, scientists have reproduced the techniques master craftsmen used to make the many ornamental, commercial and ritual artifacts excavators have recovered from the long-buried ruins of the Indus cities. Reading their fine handicrafts for clues, archaeologists are at last developing a more detailed portrait of this extinct civilization.

urban cultures, linguists have yet to decipher the Harappan script we see on recovered seals, amulets and pottery vessels. In our ongoing attempt to understand how the now vanished people of the Indus culture ordered their society and to determine the sources of political, economic, military and ideological (religious) power in this remarkably extensive and urbanized state, my co-workers and I have to draw clues from the miscellaneous material we dig up and from the layout and architecture of the cities and settlements we excavate.

The Harappan writings have not been totally useless, however. Although our inability to translate the symbols that artisans and others inscribed on objects has prevented us from learning directly how certain individuals and communities gained and maintained power, we have gleaned insights from examining the context of the writing's use. These studies, together with recent analyses of the advanced crafts that have survived the centuries at Harappa, have begun to yield a new understanding of the social power structure in the Indus civilization.

Hidden Cities

IN THE 1920S archaeologists excavating old mounds of soil and refuse that covered the two large Bronze Age cities of Harappa and Mohenjo Daro ("Mound of the Dead" or "Mound of Mohen") in what are now the Pakistani provinces of Punjab and Sindh brought the Indus civilization to the world's attention. That a major state had flourished on the rich floodplains of the great trans-Himalayan river was unexpected. Subsequent surveys and excavations in western India and Pakistan have uncovered more than 1,500 additional settlements distributed over an area the size of western Europe and twice that of Mesopotamia or ancient Egypt. Although the Indus Valley people did not produce monumental stone carvings and did not bury their dead with their wealth, they con-

structed large, well-planned cities and made exquisite luxury items that were traded and exported to distant markets in the Persian Gulf, Central Asia and Mesopotamia. The similarities in site layout and artifact style throughout the Indus region reflect a surprisingly uniform economic and social structure.

In 1986 the late George F. Dales of the University of California at Berkeley established the Harappa Archaeological Research Project, a long-term multidisciplinary study effort that I now co-direct with Richard H. Meadow of Harvard University and Rita Wright of New York University, in collaboration with Pakistan's Federal Department of Archaeology and Museums. We conduct on-site investigations and laboratory research to study the original Harappan settlement and to trace the evolution of the larger city that emerged at the site. That work has revealed several phases of development.

The Indus cities established their economic base on agricultural produce and livestock, supplemented by fishing and hunting. Both the common people and the elite classes derived additional income from the production and trade of commodities, including cotton and woolen textiles as well as a variety of craft items.

The earliest village settlement at Ha-

rappa (called the Ravi phase) dates from before 3300 B.C.E. to around 2800 B.C.E., a time when the Sumerians were building their first ziggurats and elaborately decorated temples and the Egyptians were burying their rulers and vast hoards of wealth in mud-brick tombs. Farming an environment similar to the agricultural lands of the Fertile Crescent in the Middle East, the ancient Indus peoples herded cattle and cultivated wheat, barley, legumes and sesame. Specialized craft technologies spread among the early settlements along trade networks, which likewise disseminated a shared set of religious symbols and artifact styles throughout the region.

Archaeologists have found other small farming communities from this period to the north and south of Harappa along the Ravi River, but none of these hamlets expanded into a larger town. In the limited exposed area of the Ravi-period Harappa, investigators have turned up signs of the production of both terra-cotta and stone beads and bangles. The terra-cotta items were probably worn by children or commoners, or both, whereas the more exotic stone and seashell ornaments most likely adorned local upper-class populations. Through careful analysis of the raw materials and comparison



INDUS VALLEY CIVILIZATION, which arose some 4,800 years ago, eventually included more than 1,500 cities and settlements spread over an area the size of western Europe in present-day Pakistan and western India.

to known source regions, archaeologists have shown that some of the raw materials used by the early Ravi craftsmen arrived at the site from 300 to 800 kilometers away. Impressions of woven fabric on small terra-cotta beads provide evidence of textile production, possibly of both cotton and wool.

This early site also contains the first indication of abstract symbols, or pictographs, scratched onto pottery. Current studies suggest that some of these symbols were retained in the later formalized Indus script, much as ancient Mesopotamian and Egyptian symbols on pottery and clay tablets from around

to be woven fabrics, a sign of growing textile production and the importance of clothing, not only for functionality but for public display.

A formal writing system, known as the Early Indus script, emerged in this phase, as evinced by its appearance on numerous pottery fragments and in impressions that a seal, or stamp, made in clay. Merchants employed seals to indicate ownership of storerooms or bundles of goods by stamping clay tags, or bullae, over a cord or a secured door. These square seals, carved in intaglio with geometric or animal motifs, served as economic documentation. Because only a

for tax or tribute, was established in Harappa two centuries before it became widespread throughout the Indus Valley.

Many religious symbols of horned human forms and ritual designs on pottery began to appear at Harappa and in far-flung corners of the Indus region during the Ravi and Kot Dijian periods, indicating the spread and synthesis of religious and cultural ideas. Whereas in ancient Egypt and Mesopotamia military conquest achieved the integration of distinct regions into single states, this pattern has not been seen in early Indus settlements. The first settlers at Harappa seem to have exploited the rich agricul-

The Indus people constructed extensive, well-planned cities and made exquisite luxury items that were exported to distant markets.

3500 B.C.E. and 3200 B.C.E., respectively, later found their way into cuneiform and hieroglyphic writing.

Between 2800 and 2600 B.C.E., Harappa became a thriving economic center. Physically, it expanded into a substantial town containing two walled sectors covering an area of more than 25 hectares—about the size of several large shopping malls. In the meantime, many related villages grew up in scattered sites nearby. During this period, called the Kot Dijian (after the site of Kot Diji to the south), artisans developed new craft technologies for making widely distributed products such as gray fired bangles and faience (a form of glazed pottery), the fabrication of which usually involved the use of high-temperature kilns [see box on page 74].

At the same time, increasing quantities of stone and other raw materials were being transported to Harappa, probably by oxcarts and flat-bottomed river boats. Toy bullock carts and wheels made of terra-cotta have been found at Harappa from this period, and the later use of carts and boats is well documented. Archaeologists have also recovered figurines of cattle and humans painted with what appear

few seals have been discovered, it is likely that they were used by individuals or communities with considerable power, such as landowners, merchants and religious leaders.

Excavations have turned up other signs of economic evolution during the Kot Dijian period. In particular, scientists unearthed a tiny cubical limestone weight. The stone cube weighs 1.13 grams, which corresponds directly with the standardized weight system of the later Indus cities. Its recovery indicates that a system of determining value by weight, possibly

tural and grazing lands along the Ravi River to sustain themselves as they built economic and political power through craft production and trade and then legitimized their standing through religious practices rather than warfare.

The City Blossoms

THE FULLY URBAN PHASE of Harappa (termed the Harappa phase) began around 2600 B.C.E. and continued until around 1900 B.C.E. For seven centuries Harappa was one of the largest and most powerful economic and political centers

EXULTANT RELIGIOUS PILGRIMS make their way along the age-old Indus Valley trade routes one town a day, bringing prayers and offerings of the faithful to a distant holy site.



BIT BY BIT, Pakistani excavators uncover the massive walls of the lost city of Harappa as archaeologist J. Mark Kenoyer (far right, in group) explains the site's significance to visitors.

in the Indus Valley, despite the seeming lack of an army. During the spring and late-summer trading seasons, the city would have hosted hundreds of traders who attracted thousands of people from the surrounding rural areas. Depending on the time of year, 40,000 to 80,000 people may have lived in the city. Wealthy patrons and entrepreneurial competition stimulated the development of new technologies and more extensive trade networks. Excavators have found distinctive pottery with widely used ritual motifs at all settlements throughout the greater Indus Valley, along with unique objects such as cubical stone weights, and seals inscribed with Indus writing and a motif depicting a mythical unicorn.

Although most traders operated within the Indus Valley region, some materials were available only from more distant locales. The presence of raw materials and finished goods from Afghanistan and Central Asia indicates that merchants from these areas came to the city bringing lapis lazuli, tin, gold, silver and, perhaps, fine woolen textiles (which have since vanished). Traders would have carried back to the highlands cereal grains and livestock, as well as fine cottons and possibly even silks, but these items are not well preserved. Other nonperishable objects, such as long, elegant beads made of carnelian (a form of red agate) and shell bangles from the Indus Valley, have been dug up in Central Asia and Mesopotamia.

In its prime, Harappa measured more than 150 hectares in area—more than five kilometers in circuit, encompassing three large raised mounds and associated suburbs. The modern town of Harappa, with a population of around 20,000, still occupies a third of the ancient site. The city's architecture and street layout were organized to facilitate access to the different neighborhoods and to segregate the public and private areas. Massive mud-brick walls enclosed each of the raised mounds [see illustration above], and narrow gates limited access, permitting only a single oxcart to pass at a time.



Masons employed kiln-fired brick to build multistory houses that were placed along north-south and east-west street grids. Major avenues spanned more than eight meters, and some featured central dividers that may have regulated two-way bullock-cart traffic.

Builders dug drinking-water wells in and around the city, and Harappan houses were equipped with bathing areas, latrines and sewage drains. Linked to larger mains, which eventually emptied outside the city walls, the sewers at Harappa would have removed wastewater from the habitation areas, depositing fertile sludge on the surrounding agricultural fields. Save for the Indus cities, no other city in the ancient world featured such a sophisticated water and waste management system. Even during the Roman Empire, some 2,000 years later, these kinds of facilities were limited to upper-class neighborhoods.

During this period, scribes developed a sophisticated writing system comprising more than 400 symbols that the society's elite classes—including traders, landowners and ritual specialists—used as a mechanism for economic control and political power. Archaeologists do not know the language for which the

script was developed, but it was probably used for writing more than one language, as was the case in Mesopotamia. We will never know for sure until someone discovers some form of bilingual tablet (an Indus Rosetta stone) that will help scholars break the code of the writing system.

This script became widespread in all the major urban centers of the Indus Valley. Its most prominent use was on seals that also bore animal motifs and ritual objects. The unicorn image [see illustration on page 68] is the most common (found on more than 65 percent of known seals), but other animals appear as well, including elephants, humped zebu bulls, water buffaloes, bison, tigers and rhinoceroses. The animal symbols may have represented important clans or official social classes; the writing probably listed the name of the owner and statements of legal legitimacy. The regular appearance of the unicorn sign indicates a widespread and powerful community, possibly merchants.

Beyond seals inscribed with writing and animal signs, excavators have found large pottery vessels for holding merchandise for trade etched with what may have been names of owners or con-

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signees, together with a description of the contents. Investigators have interpreted examples of script scratched on bronze tools and gold jewelry as personal names or values.

We also see for the first time small tokens or tablets made of steatite (soapstone) incised with script and symbols. Because many of these items feature the same set of signs and what appear to be numbers, researchers think that they served as tools for accounting. The writing may indicate the owner's name, the commodity and its quantity or the creditor to whom it is being presented. Similar tablets made of clay or faience that were stamped with a seal are found quite commonly in the later levels of the site. Some of these tablets have been intentionally snapped in two, possibly to indicate a contract between two parties, each of whom retained half until the transaction or work was completed. Distinctive copper tablets with script and animal motifs and their widespread use in Mohenjo Daro and Harappa are perhaps the earliest evidence for a form of city coinage in the Indus Valley.

Our discovery in 2001 of a workshop that manufactured seals and inscribed tablets at Harappa [see box on page 74], combined with the past 16 years of excavation at the site, has provided a new chronology for the development of the Indus writing. In the past, scholars had lumped all the seals and tablets together, but now we can demonstrate that differ-



TELLTALE TOOL MARKS become visible when the author examines ancient Indus Valley artifacts with a scanning electron microscope at the University of Wisconsin–Madison.

peting processes—the desire to differentiate among communities and classes within the cities and attempts to integrate these separate groups by promoting a common ideology.

In this period, we see writing combined with narrative mythological scenes that indicate its use related to religious themes. Spiritual leaders most likely used seals and tablets to communicate the names of deities and rituals to the common people. Although researchers do not know the names of the Indus deities, we see the repeated motif of a seated male

gamesh epic, in which the hero strangles a pair of lions. The similarities between these motifs are evidence of shared concepts of power and dominance, but we do not know if the specific narrative spread from one region to the other.

As Harappa began to host more people from foreign lands, the elite classes probably felt the need to help legitimize their rule through public rituals and ceremonies that reinforced the principal religious traditions. In Mesopotamia and ancient Egypt, political and religious leaders accomplished this task by con-

Scribes developed a writing system that the society's elite used as a mechanism for economic control and political power.

ent types of seals and tablets emerged at various times and that the writing itself may have changed over the years. We are currently trying to reach conclusions about the dating of the script changes and expect that this chronology will revolutionize the attempts at decipherment.

Between 2300 and 1900 B.C.E. the urban populations in the Indus Valley expanded, and ornaments, tools and manufacturing technologies grew increasingly diverse. Archaeologists believe that these stylistic changes reflect two com-

figure in a yogic position, wearing a horned headdress. In one set of narratives, a buffalo is sacrificed in front of the seated deity; in others, he is surrounded by ferocious wild animals. Female deities are also depicted on seals, sometimes with a horned headdress and fighting a tiger. A theme on many seals and impressions on clay tablets is that of a deity strangling two tigers, in some instances depicted standing on top of an elephant. A similar scene found in Mesopotamia is associated with the Gil-

structing massive stone or brick murals covered with religious and political propaganda depicting rulers conquering their enemies, but no similar artifacts have been unearthed in the Indus Valley.

The Indus Culture Changes

PREVIOUSLY SCHOLARS argued that the Indus cities were suddenly abandoned around 1750 B.C.E., but our recent work at Harappa has clearly demonstrated that during its late phase, from 1900 to 1300 B.C.E., Harappa was indeed

What the Beads Say

OUR EXCAVATIONS at Harappa have yielded stone beads from all the major occupation phases of the site, indicating that the inhabitants produced them from the earliest settlement onward. Other evidence, particularly small figurines of city dwellers adorned with copious quantities of jewelry, reveals that Harappans often wore multiple strands of beads made from colored and patterned stones. Some of the bead-making areas that we uncovered were probably sponsored by the elite urban classes and produced rare, difficult-to-make beads as symbols of wealth, status and power.

From the unfinished samples and the remains of workshops, we have been able to document how bead styles and drilling techniques evolved over 1,400 years. This continual elaboration was probably stimulated by competition between workshops, market demand, and encouragement by wealthy patrons to create more valuable and attractive ornaments.

The desire for high-quality beads, and thus refined fabrication methods, was strong even in the early Ravi phase (3300 to 2800 B.C.E.) of Harappa. Although it is relatively simple to make large stone beads, by far the most prevalent types during that period were quite small, between 1.5 and three millimeters in diameter and one to two millimeters long. These were particularly difficult to fashion because, for stringing, they needed tiny holes (one half to three quarters of a millimeter across).

Some of the earliest beads were fabricated from steatite, a soft talc also known as soapstone. Archaeologists have recovered more steatite beads than any other type, and they occur in all parts of Harappa, dating from the Ravi phase through the Late Harappan (1900 to 1300 B.C.E.). Artisans easily bored holes in roughly formed beads of steatite using copper drills or even hardened acacia thorns about half a millimeter in diameter. Then they ground the unfinished beads to size and polished them on grindstones.

Finally, the workers fired the beads in kilns, turning them white and converting the mineral into a harder, more durable form.

Some beads of steatite were left with a rough surface, which artisans coated with a finely ground silica frit (a glassy paste made of quartz powder) mixed with copper oxide, which yielded a blue-green glaze when heated. When fired at more than 850 degrees Celsius (1,562 degrees Fahrenheit), steatite crystals give off water and transform into much harder minerals, including cristobalite, enstatite and alumina. Many craftsmen of the Indus region practiced this kind of processing, which may have served as the foundation for later vitreous glazing procedures employed to fabricate faience ornaments, seals and tablets.

From the Ravi through the fully urban phase, bead makers in Harappa and other Indus cities also worked harder stones, such as

agate and jasper, which required other drilling techniques: pecking with a stone or copper tool followed by boring with a harder variety of stone drill. Indus scholars have not replicated the pecking technique, so it is not well understood. But it is known that workers perforated some beads with hard stone drills made by shaping tiny slivers of stone into long, tapered cylinders. Hafted onto a thin wooden dowel and turned with a bow, these drills penetrated the beads halfway through from each side to form a continuous passageway for the string. This process was tedious, as both the stone drills and the beads were of approximately the same hardness.

Around 2600 B.C.E., Indus craftsmen discovered a much tougher stone drill, which we have called Ernestite, in honor of English archaeologist Ernest J. H. Mackay, who first discovered it in Chanhudaro, Pakistan. These highly effective drills remain something of a mystery, and despite numerous studies and surveys, we have not yet discovered their precise composition or their source area. Ernestite seems to contain various minerals, and preliminary analysis suggests that it is a fine-grained metamorphic rock

composed mostly of quartz, sillimanite, mullite, hematite and titanium oxide. Mullite is rarely found in natural form but is produced in modern high-temperature ceramic materials. Its occurrence in the drills hints that it is the by-product of intentional heating of the original rock, a process that was widely practiced by Harappan craftsmen for hardening steatite and making other rocks easier to chip.

Although we do not know where the first Ernestite drills were manufactured, so far they have been found only at sites in the Indus Valley, which implies that they were unique to that region. They gave the craftsmen a way to make exquisite carnelian beads that were worn by the Indus elites and traded to peoples in Central Asia and Mesopotamia, including Ur. People

often wore the long carnelian beads as a belt of multiple strands that were held in place with polished bronze spacers.

Harappan bead makers used Ernestite drills for seven centuries, but around 1900 B.C.E. this drilling technique disappeared in the northern sites, perhaps because of the disruptions in trade networks that occurred at that time.

But the drilling of beads did not stop. Later artisans began perforating stone with hollow tubular copper drills used in combination with abrasives. The Harappans had always employed this method for hollowing out large stone rings and alabaster vessels, but then they miniaturized the technique, working with tiny tubular drills only a millimeter in diameter. Though not as efficient as Ernestite drills, the copper drills could perforate relatively hard stone beads by working halfway through from each side. —J.M.K.



MASTER ARTISANS of the Indus used complex grinding, drilling and decorating methods to fashion colored minerals, often imported from far afield, into exquisite beadwork.

Secrets of Harappan Glazing Techniques

FAIENCE, AN ATTRACTIVE glazed ceramic or stone featuring a lustrous sheen, is one of the complex craft techniques used by artisans to create high-status goods for elite consumers throughout Harappan history. Indus Valley faience was stronger than that from Egypt or Mesopotamia because it was made with partially melted quartz that was reground into a fine paste before a second firing, which fused the glassy powder to the core of the object. The Indus artisans needed a stronger form of faience because they were making different types of objects than those used in other regions, specifically faience bangles. They also produced tiny glazed beads and delicately molded tablets inscribed with written symbols used as credit tokens to keep accounts of goods coming into or moving out of the cities.

The Harappan elite classes employed faience not only for decoration and commerce but for ritual purposes as well. Tablets bearing narrative scenes may have been manufactured for special ceremonies and handed out to participants who had offered donations or sacrifices. Control of faience production techniques and the fabrication facilities was essential for Harappan elite classes to create and maintain their symbols of status and power.

Although workers produced faience from easily obtained materials, the technical expertise needed to process them into finished goods was highly specialized. Artisans partially melted powdered rock quartz in high-temperature kilns, using flux additives (fusion aids) made of plant ash to create a glassy frit. They then reground the frit, which they refired at around 940 degrees Celsius (1,724 degrees Fahrenheit) to create dense, glazed faience. When copper oxide or azurite was added to the frit, the resulting goods resembled turquoise or lapis lazuli but were much less likely to discolor when worn against the skin in a hot and humid climate.

Archaeologists have found manufacturing debris from faience production throughout the habitation layers in various parts of Harappa, but for 70 years they had failed to locate faience kilns. Our discovery in 2001 of a small faience workshop revealed that researchers had been looking for the wrong type of kiln. This find was akin to discovering the Harappan mint, because the workshop was also used for making steatite (soapstone) tablets, as well as beads and other ornamental objects—all objects of wealth.

Painstaking excavation and mapping of hundreds of artifacts from the workshop allowed us to reconstruct some of the processes used to fabricate beads, bangles and tablets. To produce molded faience tablets, craftsmen first sawed raw lumps of steatite into thin slabs and then carved them in reverse images to make molds. They used these molds to form tiny tablets that were placed in

pottery containers made of sand and straw-tempered clay that would not melt down at the high temperatures needed for glazing. To keep the glazed tablets and other objects from sticking to the pottery firing container, the inside surface was thickly coated with a coarse white powder consisting of burned bone and sometimes ground-up steatite.

No kiln was discovered in the small workshop area, even though we recovered large quantities of charcoal, frothy vitreous yellow-green faience slag and broken firing canisters. After carefully examining the containers and vitrified supports used to stabilize them during firing, I began to suspect that the artisans had relied on a novel firing method. With the assistance of my graduate students, I was able to successfully test this procedure through an experimental reconstruction undertaken at the University of Wisconsin–Madison during the summer of 2001.

It looks as if the Harappan faience glazers assembled two firing containers to form a mini kiln, rather than using bigger, more conventional firing structures. If heated in an open bonfire, they could reach temperatures high enough to glaze small objects. In the experiment, I replicated faience paste as well as the canisters and molds with materials and tools similar to those used by the ancient Harappans. We placed the molded prefired faience tablets and other test objects, including the steatite molds, in the container and covered it with a lid. Then we inserted conical supports to hold the lid up and to leave a small gap to allow flames to enter the miniature firing chamber. I positioned the canister on a low pile of firewood, covered it with more wood and lit the fire, adding more fuel to keep the assembly red-hot.

After about three hours of firing, the faience objects, just barely visible in the crack between the lid and the lower canister, began to glow a deep red-orange and to emit a distinctive odor. Using a thermocouple with a digital pyrometer, we were able to document the firing temperature at around 935 degrees C, the critical glazing point for Harappan faience. We maintained this temperature for about an hour by adding more wood.

After the mini kiln had cooled down, my students and I gathered around to observe the results. Though not identical to faience objects created by Harappan master craftsmen, fully glazed faience tablets and beads resulted. This first attempt of ours indicates that the canister-kiln technique would have been a highly efficient method for producing faience and fired steatite objects. Even more important was that the remains of the process—a pile of charcoal and ash, a cracked firing container, some discarded conical supports, charred bone, and a few rejected beads and tablets—closely resembled what we had found in the workshop at Harappa. —J.M.K.



PRODUCTION of glazed stone and ceramics, known as faience, required Indus craftsmen to develop sophisticated coating and firing techniques. Copper oxide-bearing minerals (center) were added to color the silica glaze blue so that it resembled precious turquoise or lapis lazuli.

STANDARDIZED STONE WEIGHTS were employed by Harappan traders to measure out high-value merchandise for sale in urban markets.



inhabited. In fact, signs that drains and city walls were not maintained provide proof of crowding and a breakdown of civic order. The remains suggest that the ruling elites were no longer able to control the day-to-day functioning of the urban center. This loss of authority must have eventually led to a reorganization of society, not just in Harappa but throughout the entire region that the upper classes had dominated for 700 years. Similar changes were occurring at the other big cities, such as Mohenjo Daro to the south and Dholavira in western India.

The crisis led to a cessation of the hallmarks of Indus elite culture. The distinctive pottery with ritual motifs and Indus script and traditional square seals with unicorn and other animal motifs disappeared. Cubical weights for taxation and trade fell into disuse, and the international trade networks began to deteriorate. Shells from the coastal regions no longer made their way to the northern sites, and lapis lazuli from the north failed to reach the sites in the plains. In Mesopotamia the texts that had recorded ongoing trade with a region called Meluhha, which is probably the Indus Valley, no longer mentioned it.

There seems to have been no single cause of the decline and reorganization of the Indus civilization but rather an array of factors. The growth of trade and the expansion of Indus settlements onto the Ganges River plain as well as into what is now the state of Gujarat in western India led to the overextension of the Indus political and economic system. Around 1900 B.C.E., one of the major rivers of the Indus Valley, the Ghaggar-Hakra (also called the Saraswati), began to shift its course and eventually dried up, leaving many sites without a viable subsistence base. These communities would have migrated to other farming regions or to cities such as Mohenjo Daro and Harappa, resulting in overcrowding and civic disorder. Without a tradition of army-enforced social integration, leaders had no mechanism for maintaining trade networks and

controlling the movement of peoples as they spread out into new regions.

The speed of change varied in different areas, but by 1300 to 1000 B.C.E. a new social order characterized by a distinctive ideology and language began to emerge in the northern Indus Valley and the Ganges River region to the east. According to ancient Indian literary records such as the Vedas and the Mahabharata and Ramayana epics, this area was populated by numerous competing polities practicing Vedic religion and speaking Indo-Aryan languages such as Sanskrit and its various dialects. Our information is hampered by the fact that most of the Indus settlements dating to this period have either been destroyed by later erosion or brick robbing or are covered by continuous inhabitation, which makes excavation impossible. Both Harappa and Mohenjo Daro supported later settlements dating to this time, but these levels have been badly disturbed.

Even though many features of elite Indus culture faded away, some aspects of its urbanism and the important craft technologies survived. Pottery, faience, and copper and bronze continued to be produced in the Indus region, although they were adapted to changing raw ma-

terials and social needs. Around 1700 B.C.E. came the first evidence for glass beads produced at Harappa, some 200 years before glass was being made in Egypt. During the subsequent Painted Gray Ware culture (1200 to 800 B.C.E.), glass bottles and bangles as well as beads were being fabricated at sites throughout northern India and Pakistan. It was then, too, that iron production—a new technology that spread throughout the northern Indus Valley and the Ganges River region—emerged. Although the peoples of Anatolia and West Asia smelted iron during this period, the iron manufacture of ancient India and Pakistan was a separate development unrelated to activities in the west.

Much of the Indus culture has yet to be investigated, but the results of recent work at sites such as Harappa are finally lifting the veil from an important civilization that has long been shrouded in mystery. SM

Ancient Indus Valley artifacts are on exhibit in “Art of the First Cities: The Third Millennium B.C. from the Mediterranean to the Indus” at the Metropolitan Museum of Art in New York City through August 17, 2003.

MORE TO EXPLORE

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For more information on Harappa, visit www.harappa.com