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Stone beads in Ancient South Asia- 7000-600 BC: A comparative approach to technology, style, and ideology.

Introduction

Stone bead manufacture and the study of beaded ornaments is a growing field of investigation in the archaeology and ancient history of South Asia (Deo 2000; Lankton 2003). Although some archaeologists still refer to beads and pendants as "miscellaneous small finds", most scholars agree that they provide a unique perspective on ancient trade networks, technological and economic organization, wealth and social hierarchy, ritual symbols, as well as chronological change. With the adoption of more rigorous excavation and recovery methods, a wide range of stone beads have been recovered from well dated contexts, along with evidence of manufacturing processes, such as microscopic remains of stone bead flaking, as well as tiny heat spalled drill tips. Although we still have much to learn about ancient bead making traditions, we can now begin to see distinct patterns of continuity and change that provide a more comprehensive understanding of the roles played by beads in the early stages of human development and the emergence of urbanism. Because of the fact that most beads are worn as a public symbol of social status and cultural identity, the study of beads can also provide a unique perspective on patterns of ancient ethnic diversity and even religious affiliation.

In order to follow the development of bead technologies in South Asia it is necessary to have a general idea of the chronology and major cultural periods. This paper will focus on the northwestern regions of the subcontinent

basic technologies used for the production of stone beads will be presented followed by more detailed discussions of shaping and drilling techniques. By learning how to distinguish specific features of manufacture, it is possible to differentiate beads from multiple time periods and different regions.

This introductory section will be followed by a summary of the major types of beads found in different sites and a discussion of the specific technological continuities and changes seen over time. Using a more complex and comprehensive approach to the study of beads can also provide new insights on the role of stone beads and pendants in economics and ideology. The long-term goal of such studies is to define specific workshop styles to track the movements of beads from a production center to consumers and on through history. In some cases, where unique patterns of tools and styles can be identified, it may be possible to identify the work of individual bead makers.

As the study of beads become more precise, it is also important to develop more comprehensive chronological frameworks for tracking the changes in bead technologies and styles. In this introductory article, it will not be possible to present the chronology and cultural periods in great detail, but it is necessary to provide the serious scholar with a brief summary in order to make the subsequent discussions more meaningful.

Table 1. Indus and Indo-Gangetic Traditions

Indus Tradition	
Foraging Era	10,000-2000 BC
Mesolithic and Microlithic	
Early Food Producing Era (Neolithic)	7000-5500 BC
Regionalization Era (Chalcolithic)	5500-2600 BC
Early Harappan Phases	
Integration Era (Bronze Age)	
Harappan Phase	2600-1900 BC
Localization Era (Late Bronze Age)	
Late Harappan Phase	1900-1300 BC
Indo-Gangetic Tradition	
Regionalization Era (Iron Age)	
Painted Grey Ware	1200- 800 BC
Northern Black Polished Ware	700-300 BC

Chronology and Cultural Terminology

The Indus Tradition refers to the long series of cultural developments taking place in northwestern South Asia in the areas of modern Pakistan, northwestern India, and parts of Afghanistan. The roots of this tradition can be traced to hunting and foraging communities of the Upper Palaeolithic or Late Stone Age and on into the Foraging Era of the Mesolithic and Microlithic cultures of South Asia. Flaking traditions for shaping stone beads and the production of stone drills have their origins in the blade technologies of the Late Upper Palaeolithic and Mesolithic/Microlithic periods. Beads made from ostrich eggshell have been found at numerous sites in peninsular India dating to the Upper Palaeolithic Period (Kumar 1997) and over one hundred beads, some of which were incised with criss-cross lines, have been discovered at the site of Patne, Maharashtra dating to around 24,000 BC (Sali 1989).

The earliest stone beads perforated with specialized stone drills can be dated to around 7000 BC during the Early Food Producing Era at the site of Mehrgarh, Baluchistan (Barthélemy de Saizieu 2003; Jarrige, Jarrige and Quivron 2005). At this settlement, there is evidence for the early

of various types of stone bead technology. The trade in stone beads as well as shell reveals the presence of vast trade networks extending over 1000 kilometers from the Makran coast to Central Asia (Kenoyer 1995). During the subsequent Regionalization Era (around 5500 BC), communities throughout the northwestern subcontinent began developing distinctive traditions of pottery and ornaments manufacture, including the production of stone beads and pendants. Both hard and soft stones were being perforated with different types of stone drills, and distinctive techniques of drilling emerged in different regions. It is during this time period that the foundations of urbanism can be traced at sites such as Mehrgarh/Nausharo and Harappa. Early Harappan is the term usually associated with the formative phase of the Harappan or Indus Civilization, which is dated from 3500 - 2600 BC (Mughal 1992; Kenoyer 1998). The Integration Era (2600 to 1900 BC) sees the emergence of the fully developed Indus or Harappan urban civilization, that extended over an area that was twice the size of contemporaneous civilizations in Mesopotamia or Egypt (Kenoyer 1998). Cities, such as Mohenjo-daro, Harappa, and Dholavira were ruled by influential elites, probably a combination of merchants, landowners, and religious leaders. Smaller towns and villages may have been run by corporate groups such as town councils or individual charismatic leaders, but there is a conspicuous absence of central temples, palaces and elaborate elite burials that are characteristic of elites in other early urban societies in Mesopotamia, Egypt and China. Hierarchical social order and stratified society is reflected in architecture and settlement patterns, as well as artifacts, such as beads, and the organization of technological production (Kenoyer 1998). A vast network of internal trade and exchange and a share ideology united the greater Indus valley. During this period, there was widespread use of similar styles of pottery, figurines, ornaments, the distinctive Indus script, seals, and standardized weights. Massive mud brick walls surrounded most large settlements, and appear to have functioned primarily for control of trade access into the cities. These walls also would have served as formidable defenses, but there is no evidence for major conflict or warfare at any major center.

Stone bead making became highly diverse during the Harappan period, partly because of the availability of

need to create different types of ornaments for the many different ethnic and social groups living in the larger cities. Beads were made from a variety of different materials, including stone, bone, shell, ivory, plant seeds, bronze, gold, silver, terracotta and glazed faience. The use of different materials and the production of a host of different bead shapes, sizes, and decorations, suggest that beads had become an integral mechanism for legitimizing and maintaining the social order. The Indus Tradition continues through the Late Harappan period (as late as 1300 to 1000 BC) and overlaps with the cultural developments that coincide with the Regionalization Era of the later Indo-Gangetic Tradition. This later period sees the emergence of farming and herding communities associated with Indo-Aryan speaking Vedic cultures (1500-800 BC) and people who used a special type of Painted Grey Ware pottery (PGW - after which they are named). The evidence for stone beads declines during the PGW period, but there is an increase in the production of glazed faience, in multiple colors and styles that are clearly imitations of stone beads. The final cultural period to be covered in this article is the early Northern Black Polished ware period (700-600 or 500 BC), which sets the foundation for the next phase of urban integration during the Mauryan Period (300 BC). During this period, there was a resurgence of stone bead making most major sites. In addition, many new technologies came to be established, including drilling with diamond tipped drill bits, faceting, tumble polishing, and coloring beads. While some of the popular literature still refers to a "Dark Age" between the period of the Indus cities and those of the Ganga-Yamuna rivers to the east, new excavations and better dating of sites shows that there are strong continuities in settlement history as well as in technologies (Kenoyer 2005).

Stone Bead Technology

The techniques used to produce stone beads are determined by several factors, but two basic criteria are the nature of the raw material being used and the technological and culturally defined choices that the bead maker applies in creating a finished ornament. A systematic study of traditional stone bead working in Khambhat, India

combined with careful examination of archaeological beads and bead-manufacturing debris can provide a general overview of the basic processes and techniques as presented below (Kenoyer, Vidale and Bhan 1991, 1994).

Table 2. Basic stages in the production of a stone bead

1. Raw Material Preparation - Heating to "soften" the rock for processing
2. Shaping - breaking, grinding, chipping, pecking, sawing
3. Perforation - hand drilling, bow drilling, pecking
4. Surface and Material Modification - heating, polishing, coloring, incising

Many rocks do not need any raw material preparation, but agates and jaspers are easier to flake and grind if they have first been dried and heated. The initial drying removes most of the water in a rock, and slow heating to around 340° C removes inter-crystalline water that makes it easier to shape in a more controlled manner. This initial heating also changes the colors of many rocks, particularly those containing iron. If the rock is heated in an oxidizing atmosphere the iron will turn red, but if the fire is smoky and has a reducing atmosphere the rock will absorb carbon and turn black or grey. A rock can be smashed, ground, chipped, sawn, or pecked to modify its shape, and although many beads are not necessarily polished before they are used, some are carefully smoothed to create an even surface that eventually becomes polished through repeated use. Chipping can be done by direct percussion, indirect percussion or by using inverse indirect percussion, as is the case in modern flaking of agate beads in Khambhat, India. This later technique involves the use of a pointed stake tipped with antler or copper (iron stakes are used today) that is set firmly in the ground. A piece of rock is held against the tip of the stake and tapped with a buffalo horn hammer. By carefully controlling the angle and force of percussion, a skilled bead maker can make a wide variety of shapes very quickly.

Not all rocks can be chipped, and therefore sawing is often used to create roughouts. Soft steatite can be sawn with a chert or copper blade, while lapis lazuli or jade

can only be sawn using an abrasive with a string saw or a copper or wooden edged saw. The abrasive made of garnet or emery sand is fixed in the softer material as the saw is rubbed against the rock with water or oil as a lubricant. Eventually a deep groove is created and the rock can be snapped into smaller shapes that can then be ground. This processes conserves valuable raw materials and also reduces the time involved in grinding. Grinding can be done on rough sandstone or quartzite slabs. Today rotary wheels are used, but in the past all grinding was done by hand against a flat stone with water being used as a coolant and lubricant. Heavy grinding without water can heat the bead and cause it to crack. This same problem happens with perforation as well, and in the drilling of beads, water is generally used to cool the bead and to wash out accumulated grinding powder.

Polishing a bead is a continuation of the grinding process, but using
increasingly fine grinding stones and eventually on wood or leather. Most prehistoric beads were polished by hand, and small beads would have been strung on a thread to allow the exteriors of all the beads to be polished at the same time. Short bicone beads would have been attached to a dop stick with adhesive to grind and polish each facet. Spherical beads would have been ground and eventually polished with a wooden vise to hold them in place and allow them to rotate to create a spherical shape. Mass polishing of beads can be achieved by placing them in a leather bag or a pot along with an abrasive, followed by up to fifteen days of rolling or shaking. This process results in a low luster polish, which also rounds any rough edges of remaining flake scars or drill hole edges.

Perforation of the shaped bead blank is done along a lateral or longitudinal axis, or at one edge. Without a perforation, the bead cannot be used, though some ornaments were attached by simple grooves in which a string could be fixed. Perforation is one of the most informative aspects of bead production, as there are several different types of drilling processes and they leave distinct marks on the inside of the bead. These marks are usually well preserved and can be used to differentiate workshop styles and regional styles of bead manufacture. Drills were rotated by hand or by using a hand powered bow drill. In some regions such as China, there is evidence

of the use of foot powered lathe drills, but this has not been documented in South Asia. The major types of drills used in the prehistoric and early historic period are listed below (Table 3). In the modern bead industry, single diamond and double diamond tipped drills continue to be used in many regions of Asia and are necessary for perforation of long agate beads. Short beads can be more economically perforated by electronically powered steel drills using diamond dust and because of this factor, they are relatively cheap.

Table 3. Common Drill types (Figure 2)

1) stone tipped percussor
2) tapered stone drill
3) tapered cylindrical stone drill
4) constricted cylindrical stone drill
5) solid wooden or metal rod shaped drill and abrasive
6) bevel tipped metal rod
7) hollow bamboo or metal tube with abrasive
8) single tipped diamond drill
9) double tipped diamond drill
10) steel drill with diamond dust

Soft stones can easily be carved, drilled, and polished to produce a bead or pendant. However, some soft stones, such as talc (soapstone or steatite) can also be heated (above 1000° C) to harden it and make it into a totally different material (Figure 3). In the course of heating, many rocks change their color and this technique was often used to create white steatite beads, deep red carnelian or pink colored cherts and jaspers. The natural surface of a stone can also be modified by painting, incising or even glazing.

The choices made in manufacture and shaping a bead have an impact on the durability of a bead and its overall cultural or economic value. A large rock with a hole may be impressive in one culture, but other communities may prefer a thousand tiny beads each with a minute perforation. Large soft stone beads made of ochre, limestone, sandstone or unfired talc are easily broken and worn down after a short period of use. Tiny hard fired steatite beads last for thousands of years. Hard stone beads of almost any size or shape, such as fired steatite, agate, jasper, and jade can be used for many

circulation and buried with the dead as offerings for the afterlife, other beads were passed on from one generation to the next and may have been in continuous use for hundreds or even thousands of years before being discarded or lost into the archaeological record.

Foraging Era - Mesolithic and Microlithic Beads

During the time period following the Upper Palaeolithic, the main raw material previously used for making beads disappeared due to the extinction of the ostrich in India. So far there is no evidence for the production of sawn steatite or soft stone beads during the Mesolithic or Microlithic periods, but given the appearance of a well developed steatite disc bead industry around 7000 BC it is highly likely that ostrich eggshell disc beads were replaced by shell or stone disc beads during the Mesolithic period. The only types of beads or pendants from this time period were made with antler in the form of ring shaped ornaments sawn with stone blades (Sharma, Misra and Pal 1980).

Early Food Producing Era - Neolithic Stone Beads

The site of Merhgarh in Baluchistan, Pakistan provides an excellent chronology of bead making beginning around 7000 BC during the Early food Producing Era and continuing through the Early Harappan, Harappan and Late Harappan periods (see Table 1). During the earliest periods at Mehrgarh the vast majority of the beads were flat disc beads, tabular forms in geometric shapes, and short to long cylindrical shapes, using both locally available and exotic raw materials (Barthélemy de Saizieu and Bouquillon 1994; Barthélemy de Saizieu 2003). Most beads were made from relatively soft raw materials; shell, limestone, steatite, serpentine, lapis lazuli and even turquoise. These beads were sawn into flat blanks and then the edges were ground and beveled prior to drilling. They were perforated by drilling with a hand held chert or jasper drill bit mounted on a rod or with a bow drill using a tapered cylindrical drill bit (Vidale 1995). A relatively small number of hard agate or carnelian beads have been recovered from the early periods, but they all appear to have been short biconical shapes that can be perforated by pecking or chipping rather than drilling. Very little hard stone bead manufacturing waste has been

found at Mehrgarh during the early periods and it is thought that most beads arrived at the site from distance workshops rather than being made at the site itself. The main exception is with steatite, a raw material that would have been brought to the site from some distant source and processes locally. During the subsequent Regionalization Era, bead making and many other crafts came to be established at the site itself.

Most of the beads recovered from the excavations of the Early Food Producing Era derive from burial offerings. In burials from Mehrgarh, Period IA (7000-5500 BC non-ceramic Neolithic) different amounts of grave goods, such as ornaments, containers, tools, and domestic goat sacrifices reflect the first patterns of differential wealth accumulation. Of particular importance to this study are headbands, necklaces, belts, bracelets, and anklets made from shell beads, and beads made from colored stones and soft steatite. Shell bangles and other burial goods were also included in some burials. Juvenile and female burials tended to have more ornaments than male burials, and the ornament styles represented in the burials are generally comparable to ornaments seen on terracotta figurines dating from as early as 5500 BC (Sellier 1988).

Regionalization Era - Chalcolithic - Early Harappan

During the following Chalcolithic or Early Harappan period, beginning around circa 4200 -3500 BC (Period III) at Mehrgarh, there is evidence for the use of hard stone drills made of jasper and the production of longer bead shapes in jasper, banded agate and carnelian (Barthélemy de Saizieu 2003). While some disc beads and tabular shapes of the earlier period continue to be produced, the more common forms are lenticular barrel, short bicone, and long bicone forms. During this same period steatite beads begin to be fired to harden them and turn them white (Vidale 1989). A similar set of both fired and unfired steatite beads from the nearby site of Nausharo (Period 1, 2800-2700 BC) are shown in Figure 3. The practice of heating and whitening steatite beads begun during this period continued throughout all subsequent periods of the Indus Tradition. The raw materials, techniques of manufacture and even the bead styles of this earlier period, clearly formed the basis for later developments in the Early Harappan and Harappan phases (Jarrige 1988). It is also possible that additional

heating was undertaken after the bead was finished and for carnelian, this was often done to produce a deeper red-orange color.

Burials at Mehrgarh during the Chalcolithic show a marked decrease in burial offerings, including beads, while terracotta figurines were increasingly decorated with a wide variety of ornaments, including necklaces, pendants, and anklets (Jarrige 1997). Female figurines (circa 3300-3000 BC, Period V and VI) are depicted with wide torques of five to seven massive strands of matched or graduated beads. In period VII (2800-2600 BC) these same torques are depicted with additional pendants or discs (Jarrige 1997). Some figurines have longer necklaces made with double or triple stands of beads that support a pendant. These longer necklaces reach to the middle of the breasts or even to the stomach. During Period VII, male figurines are depicted with three to five discs and a single pendant bead reaching to the middle of the chest. This pattern suggests that while the inhabitants were producing and wearing more varieties of ornaments, they were no longer burying these forms of wealth with the dead but were passing it on to subsequent generations.

Excavations at Harappa in the Early Harappan, Ravi Phase (+3500-2800 BC) and the subsequent Kot Diji Phase (2800-2600 BC) provide an interesting contrast to the data from Mehrgarh. Unlike Mehrgarh, which began its history by importing finished beads, the early Ravi levels at Harappa have evidence for local manufacture of both soft and hard stone beads (Kenoyer 2005). This indicates that bead makers were among the first settlers at the site and may have contributed significantly to the economic growth and overall wealth of the inhabitants. All rock used to make beads, grinding stone and stone tools at Harappa were brought to the site from distant resource areas. While many people at Harappa used easily procured clay to make terracotta beads, others preferred to adorn themselves with beads made from exotic materials (Figure 4). Lapis lazuli was brought from over 800 km to the north in Badakhshan, Afghanistan; Amazonite and carnelian from Gujarat, some 800 km to the south; steatite from Hazara some 500 km to the north, chert for drills came from 300-400 km to the northwest and south, and grinding stones for shaping the beads came from 100 to 300 km to the north or west (Law 2005; Law 2006). The vast networks needed to sustain the early bead industry at Harappa demonstrate the importance of stone beads to the early inhabitants. The most common shapes of beads were small discs, but short bicones, long cylindrical beads, and a wide variety of other shapes are common in terracotta. The tiny steatite beads were probably drilled with copper drills, short carnelian beads were perforated by pecking, and longer beads of carnelian, jasper and amazonite were drilled with tapered cylindrical drills made of chert or jasper (Figure 2).

During the following Kot Diji phase at Harappa, there are increasing varieties of agate, sandstone, carnelian, limestone and possibly even obsidian being used for making beads. This dramatic increase in the variety of raw materials is also noted at the site of Nausharo, Baluchistan (Barthélemy de Saizieu 2003), but there also appears to be a decrease in the varieties of shapes and sizes of beads being produced (Figure 5). This suggests that while there was less individual freedom of expression and more standardization in the production of beads and their use at the site. It is possible that this pattern is due to the emergence of mass production beads along with pottery and other objects such as mud brick. However, the increasing variety of raw materials suggests that ornaments with similar shapes of beads were distinguished by the varieties of combinations of different colors and bead materials. Further studies are needed to determine if this initial pattern is confirmed at other Early Harappan sites. By the subsequent Harappan Phase, there is again an increase in raw materials as well as shapes and sizes of beads (Figure 6).

Integration Era - Bronze Age Stone Beads

Bead making during the prehistoric period of South Asia reached a high point during the rise of cities and the expansion of trade networks. This burst of artistic and technological expertise can be linked to the emergence of cities and towns populated by people from many different social, cultural, ideological and ethnic backgrounds. Beads, along with bangles and other ornaments, as well as textiles would have been essential to differentiate urban dwellers. The expansion of Harappan settlements into resource rich regions of Baluchistan, Gujarat and Afghanistan, my have been stimulated in part by the need to acquire more unique and exotic materials. The end results was a wide array of stone beads and other ornaments as well as many forms of imitation materials (Figure 7)

The Harappan bead makers used many of the same raw materials selected during earlier periods, steatite, fired steatite, banded agates, carnelian and other multicolored rocks, but they acquired these from multiple sources and made a special attempt to chose uniquely patterned rocks. By careful chipping and grinding they were able to accentuate certain patterns of banding, dots, circles, or mottling that were present in the natural stones (Figure 8). They also searched for new and unique materials that could only be worked with highly specialized tools. The hard green stone caller Grossular or Vesuvianite is too difficult to drill using the common chert or jasper drills. However, Harappan bead makers discovered a unique hard stone called "Ernestite" that was used to make constricted cylindrical drills (Figure 2) to perforate Vesuvianite as well as to make long biconical carnelian, jasper and bloodstone beads (Figure 9) (Kenoyer and Vidale 1992). The source of "Ernestite" raw material is still unknown, but it may come from some localities in Baluchistan or Gujarat. This drill material was discovered and used exclusively by Harappan bead makers and was not traded to outside areas, though some Harappan bead makers appear to have taken some "Ernestite" drills to Mesopotamia to make beads in that region (Kenoyer 2007).

Harappan artisans however, did not limit themselves to the natural rocks alone, and the invented new ways to process commonly available materials, such as terra cotta, fired steatite, or faience, to create copies or imitations of the natural stone beads. They painted terracotta with red ochre to make it look like carnelian and used white and red pigments to decorate steatite to make it look like orbicular jasper or bleached carnelian. Faience was the most versatile material because it could be prepared with different colorants to create black, yellow, green, blue, red, or white beads, as well as combinations of these colors to make variegated jaspers and banded agate. This need to create imitation stone beads suggests that there was a great consumer demand for specific styles of ornaments that may have had religious importance or simply were a symbol of social status. From a distance, these imitation materials would have looked like the real thing, and some of the faience replicas of turquoise and lapis lazuli are so convincing that it requires a microscope to differentiate them even today.

During the Harappan phase, ornaments made with beads became quite elaborate and were constructed using many different colors and shapes of beads, combined with gold or silver fittings. The earlier fashion of wearing several necklaces with discs or long beads as pendants continued in the Harappan phase, where both male and female figurines are depicted with chokers or short necklaces bearing three or more long pendant beads. Some of the more elaborately adorned female figurines have layers of necklaces extending to the waist, each with several long pendant beads.

In addition to being worn around the neck, long carnelian beads were used to make girdles or belts that are often depicted on females figurines and occasionally complete examples have been found in jewelry hoards (Figure 7) (Marshall 1931; Kenoyer 1998). These relatively heavy carnelian beads were combined with small spherical beads, multiple hole spacers and terminals, all made from copper / bronze. Traces of gold leaf indicate that these copper / bronze components were originally covered with gold (Marshall, 1931:Vol. 1:34). A similar necklace or girdle, also with copper/bronze components was found in excavations at the small site of Allahdino, Pakistan (Kenoyer 1998). These hoards are usually comprised of gold, silver and copper/bronze ornaments as well as exquisite stone beads made from agate, carnelian, jasper, and turquoise. Although there are some examples of necklaces or bracelets made exclusively of gold components, most of the ornaments are made from several varieties of raw material.

One important feature of the long carnelian beads is that when they were accidentally broken, they were often reground to make into shorter beads. The original shape of the beads was a long truncated bicone, but over time, the central ridge was worn down so that they were often referred to as long barrel-bicones (Marshall, 1931; Mackay 1938, 1943). Identical beads, made by Indus bead makers living in Mesopotamia were not used and reused for such long periods of time but were rather buried in the royal tombs of Ur and other sites. These bead are relatively unworn and the central ridge is well defined, like the unfinished and broken beads from the ancient workshop in Chanhu-daro, Pakistan (Mackay 1943).

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Localization Era - Late Bronze Age

Around 1900 BC some important changes took place in the bead industry and the overall trade system that supported the Indus cities (Kenoyer 1995). These changes were directly linked to other systemic changes that were impacting the entire structure of Harappan society. The major cities and their supporting settlements began to loose power due to shifting river patterns.The eventual drying up of the Saraswati-Ghaggar- Hakra River that flowed to the east of the Indus, resulted in the abandonment of many sites and migration into the Indus valley, Gujarat or to the Ganga-Yamuna valley.The disruption of agriculture would have in turn undermined trade networks and eventually there was a collapse of both the old political many aspects of Harappan ideology. Because of the disappearance of many distinctive features of the Indus culture, earlier scholars referred to this period as the collapse of the Indus civilization. The Indus script and inscribed seals, the use of cubical stone weights and many forms of symbolic objects ceased quite rapidly, and though this did not happen everywhere at the same time, it gradually led to the reorganization of urbanism and the emergence of new technologies.

New excavations in the Ganga-Yamuna region (Kumar 2004) and in Rajasthan (Shinde 1991; Shinde and Possehl 2005), along with recent work on a range of technologies (Kenoyer 2005) are beginning to demonstrate that there was a transformation rather than a collapse (Possehl 1997). Other social and religious factors also contributed to the gradual reorganization of trade and technology and the emergence of new cultural, political, and religious traditions. In spite of many discontinuities, there are in fact some important continuities. In the context of this article, it will be necessary to focus on stone beads

them. First of all, the breakdown in trade networks resulted in limited or no access to many distant raw materials. Marine shell and carnelian from Gujarat were no longer being shipped to sites in the central and northern Indus valley. There also appears to be a decline in access to specific stone resources such as lapis lazuli from northern Afghanistan and Grossular-Vesuvianite from northern Pakistan (R. W. Law, Personal Communication). "Ernestite" drills used to perforate hard stones and make long carnelian beads were no longer used in Gujarat or in any other region of the greater Indus valley. These drills appear to have been made from a highly controlled material and when the ruling elites or merchants who knew where to obtain drill raw material lost power, they may have taken the knowledge of the resource area to their graves. The disappearance of this important bead making tool suggests that either the source was kept secret and was lost in the late phase or that the source was from outside the region, for example in Baluchistan. This apparent breakdown in long distance trade appears to have stimulated innovations in faience and glass making, as well as new bead drilling techniques for hard stone. Tiny tubular drills were used with fine abrasive to perforate small stone beads (Kenoyer 2005). Faience was used to create white beads and pendants that look very much like shell, deep blue beads that look like lapis lazuli (Figure 10), and black and white banded beads to that look like agate (Figure 11). Eventually, this experimentation led to the discovery of glass and the production of glass beads during the Late Harappan period, around 1700 BC (Kenoyer 2005). Since these technologies did not diffuse from outside the Indus region, it is only logical to suggest that they appear to reflect a creative environment stimulated by demand for high status items by elites who were part of a diverse urban population. In other words, beads tell us a very different story from what archaeologists first thought about this time period. In contrast to the bead making traditions in the northern Indus valley, recently excavated Late Harappa sites such as Sanauli (Sharma, Nauriyal, Prabhakar and Vishnukant 2004), just north of Delhi, India are revealing a new picture of technologies in the Ganga-Yamuna River valley. Sanauli is a large Late Harappan cemetery (circa 1900-1000 BC) located near to a settlement that is still occupied by modern villages. In this cemetery are extended burials

goods such as copper swords and sheaths, gold ornaments, and both stone and faience beads (**http://asi.nic.in/asi'exca'2007'sanauli.asp**). Many of the faience beads have similar designs and forms with those found during the late phase of the Harappan occupation at Harappa (circa 2200-1900 BC), but there are also new forms that are unique to this region. The stone beads include long barrel shapes in banded black and white agate or carnelian, two color zone beads of carnelian and white chalcedony, and black and white zone beads.

While some of the beads have a high polish from long use, others have a low luster polish that indicates they were placed in the burials without being used for a long period of time. Initial studies of the bead drill holes indicate that these beads, particularly the long carnelian and long banded agate barrel beads, were made with tapered cylindrical drills (V. N. Prabhakar and D. V. Sharma Personal Communication). This suggests that the technique of tubular copper drills as seen at Harappa was not used in this region and that the bead makers were using some local form of chert or jasper for drills. So far, no drills have been recovered, as the excavations of the settlement area have not been undertaken. One unique bead in the burials is however clearly not made from local agate or by local drilling techniques. This bead is a banded black, white, and brown agate that has a lenticular section and diamond shaped plan. It is identical to beads found in the Bactro-Margiana culture in northern Afghanistan and may have been an heirloom traded across the Indus valley to the Ganga-Yamuna region. Its presence in this region indicates that even though there are no longer strong trade networks linking Afghanistan and the Gangetic plain, a few exotic items did occasionally make it to distant consumers.

The Localization Era of the Indus Tradition overlaps with the Regionalization Era of the Indo-Gangetic Tradition, when communities in the Ganga-Yamuna region begin to develop distinctive regional cultures (Kenoyer 1997; Kenoyer 2005). Excavations at sites such as Bhagwanpura (Joshi 1993) and Hastinapura (Lal 1954-55) provide an important chronological sequence for the overlap and early development of what some term the Ganges Civilization (Roy 1983), but is referred to as the Indo-Gangetic Tradition.

Indo-Gangetic Tradition –Regionalization Era

During the Regionalization Era of the Indo-Gangetic Tradition, there is evidence for gradual expansion of farming and pastoral communities into the central Ganga-Yamuna river valley and adjacent regions. These communities continued to use earlier technologies of stone, faience and glass bead making, but also began to develop new ways of working these materials. In addition, they began to extend their trade networks to the east and south into peninsular India and reestablished earlier trade networks between the northwestern highlands of Afghanistan, and the southwestern coastal regions of Gujarat and the Indus valley (Kenoyer 1995). This period is complicated by the fact that very little horizontal excavation has been carried out on early settlements and there are still many questions regarding the relationship between archaeological evidence and literary evidence from Vedic and late Vedic texts (Kenoyer 2006; Thapar 2006).

The earliest distinctive cultural tradition is referred to as the Painted Grey Ware Culture (1200-800 B.C.), whose main settlements are located in the northern Gangetic plain and down the Ghaggar-Hakra river valley, with some possible sites in the Malwa Plateau. The PGW represents an indigenous cultural development from local Chalcolithic communities in the northern subcontinent and that it does not reflect an intrusive culture from the northwest. The Northern Black Polished Ware culture (700-300 BC) (Roy 1986) is the term given to the next major cultural development but in this discussion we are only concerned with the early NBP, which dates from around 700-600 (or 500) BC, prior to the emergence of major urban centers and the formation of state level societies. There have not been any comprehensive studies of stone beads from the PGW and early NBP sites and most archaeologists simply list the different types of materials and general shapes. It is not known if beads were being made at a specific site or if they were being traded from other distant workshops. The main types of beads are similar to those found at the site of Sanauli, for example long barrel beads of banded agate, jasper and carnelian. However, spherical carnelian beads are also reported from many sites and this form may represent a new trend in bead making, as they are not that common in the

Harappan and Late Harappan period. Lapis lazuli is rarely found in the PGW sites but this material does become more common in the early NBP and indicates the gradual opening of trade connections with the northwest. Similarly, the use of marine shell is also quite uncommon in the PGW, but it increases in the early NBP, indicating a similar expansion of trade networks to the coastal zones of Gujarat and eventually to South India. Throughout this period, glass beads become more common with starting with simple monochrome spherical, short barrel or biconical beads of green or black. Some glass beads were made with layers or applied colors to create eye designs in black, but by the early NBP period there are many shapes of beads and varieties of multiple colored beads (Roy 1983). Sites such as Taxila (Marshall 1951) in northern Pakistan and Kausambi (Sharma 199) in the Ganga-Yamuna region have large collections of stone beads dating to the NBP period, but no detailed technological studies or comparative stylistic studies have been undertaken. Similar sites are also found in the northern Indus valley, such as the unexcavated site of Bawani, near to Harappa (Figure 12). Preliminary examination of these beads and information gained from the available published material indicates that a more in depth studies will lead to some important new perspectives on the role of beads during the Early Historic period. One of the major new developments seen in the production of stone beads during this time period is the introduction of faceted hard stone beads such as rock crystal, amethyst, and garnet. Although rock crystal and even a few examples of garnet have been reported from the prehistoric period, the faceting of beads to capture and reflect light was never practiced. One other important development that still needs additional study is the use of single and double diamond tipped drills for perforation. Megalithic burials in Central India dating to the early Iron Age (circa 1000 BC) have evidence for a wide variety of agate, carnelian and bleached carnelian beads. These beads appear to have been drilled by both pecking, as well as with some form of rotary drill. Detailed technological studies have not been undertaken yet, but initial examination suggests that some of the beads may have been drilled with diamond tipped drills (Kuldeep Bhan, Personal Communication). The site of Nagra, Gujarat has conclusive evidence for the use of double diamond tipped drills in the early NBP period dating to before 600 BC (K

and Vidale 1992) and if this can be demonstrated for the Megalithic beads, then diamond drilling may have begun as early as 1000 BC. It is highly likely that this practice was developed first in central India where diamond gravels are found, but the practice quickly spread to the major cities of Gujarat and then throughout the Gangetic region.

Finally it is important to discuss the role of mass polishing or tumble polishing. With the increased ability to perforate beads quickly using diamond drills, it was also necessary to develop more efficient methods of polishing. The earliest clear evidence for tumble polishing is revealed at the site of Nagra, Gujarat during the Kushana Period, around 1st to 2nd centuries AD (Kuldeep Bhan, Personal Communication). Nagra is located near to the modern bead making center of Khambhat and was one of the important trade emporiums and a regional capital during the Kushana period.

Conclusion

In this general overview it is possible to see that there are many ways in which beads can be used to gain insight into the development of prehistoric technology, as well as economic and ideological systems. From simple chipping and pecking to mass production with tumble polishing and diamond drills, beads provide a unique history of human cultural development. The change in burial traditions between the Neolithic and later Chalcolithic periods also reflects different perspectives on what to do with personal or community wealth.

As archaeologists develop new methods of recovery and conservation, they are also challenged to develop new methods to analyze raw materials and beads. Theoretical approaches and interpretive models need to be refined and eventually correlated with similar studies of other objects. Through such studies of the different components of the ancient Indus Tradition and the Indo-Gangetic Tradition it is possible to break through the barriers of understanding that have resulted from the absence of written documents. As we gradually understand more about the nature of this early urban civilization we can begin to define its relationships to contemporaneous civilizations in West Asia and its contributions to later cultural developments in this region of the world.

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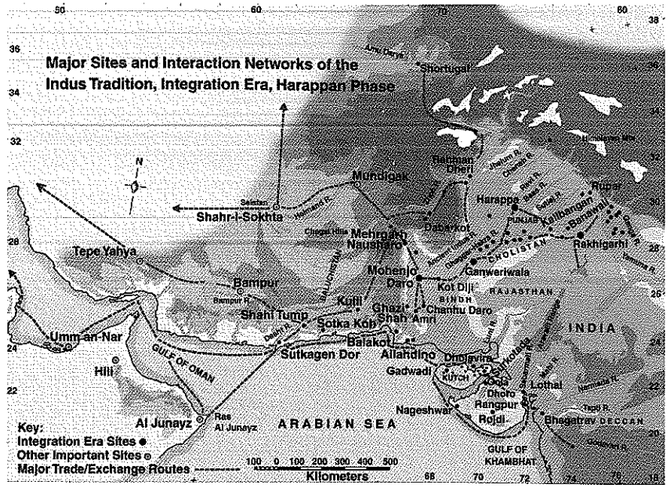

All Photos and Drawings by J. Mark Kenoyer. All archaeological beads from Pakistan have been photographed courtesy of the Harappa Archaeological Research Project and the Department of Archaeology and Museums, Govt. of Pakistan. All scales in cm.
Figure 1. Greater Indus Valley and Majors sites of the Integration Era

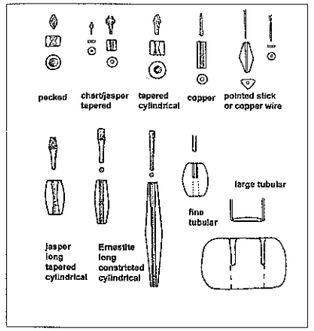

Figure 2. Drill types

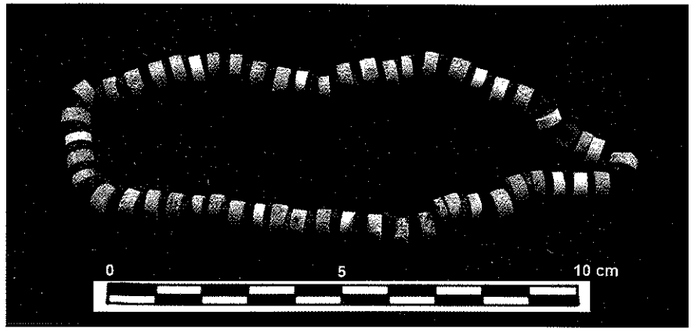

Figure 3. White fired and black unfired steatite disc beads from Nausharo, Pakistan, Kot Diji Phase, circa 2800-2700 BC. Courtesy of J.-F. Jarrige and the Department of Archaeology and Museums, Govt. of Pakistan.