Contemporary stone beadmaking in Khambhat, India: patterns of craft specialization and organization of production as reflected in the archaeological record

Jonathan Mark Kenoyer, Massimo Vidale and Kuldeep Kumar Bhan

Introduction

At present, the city of Khambhat in western India is one of the largest stone beadworking centers of the world, and it has been an important center for over two thousand years of documented history (Arkell 1936; Trivedi 1964) (Fig. 1). Using archaeological evidence, the stone bead industry in this region of India can be traced back even earlier to the cities and villages of the Harappan Phase of the Indus Tradition, dated to around 2500 BC (Hegde et al. 1988; Kenoyer 1986; Rao 1973). Because of the long continuity of stone beadmaking in this region, Khambhat provides a unique opportunity to study the organization of a specialized craft and understand how different aspects of social, economic and political organization relating to such crafts might be reflected in the archaeological record.

In archaeological studies of urbanism and so-called 'complex societies', craft specialization has come to be used as a major indicator of socio-economic complexity, stratification and centralized control. However, the many different definitions of specialized crafts and the contrasting interpretations of their role in prehistoric societies have led scholars to emphasize the need for more reliable interpretive models that correlate the socio-economic aspects of specialized crafts with the patterning of artifacts in the archaeological record (Tosi 1984; Vidale 1989; Kenoyer 1989).

One of the most effective methods for developing such models is through long-term ethnoarchaeological and experimental studies of specific craft industries in cultural contexts where historical continuities and similarities in technology are present (Kenoyer 1986; Kramer 1982; Sinopoli and Blurton 1986; Vidale 1985). Over the past ten years, the authors have collaborated in the study of archaeological craft indicators and in ethnoarchaeological studies of specific crafts, particularly stone bead manufacture. In 1989 and 1990 it was possible to conduct a detailed and multifaceted study of stone bead production in the city of Khambhat, Gujarat. Because of the complex character of the traditional beadmaking

World Archaeology Volume 23 No. 1 Craft Production and Specialization
 0043–8243/91/2301/044 $3.00/1

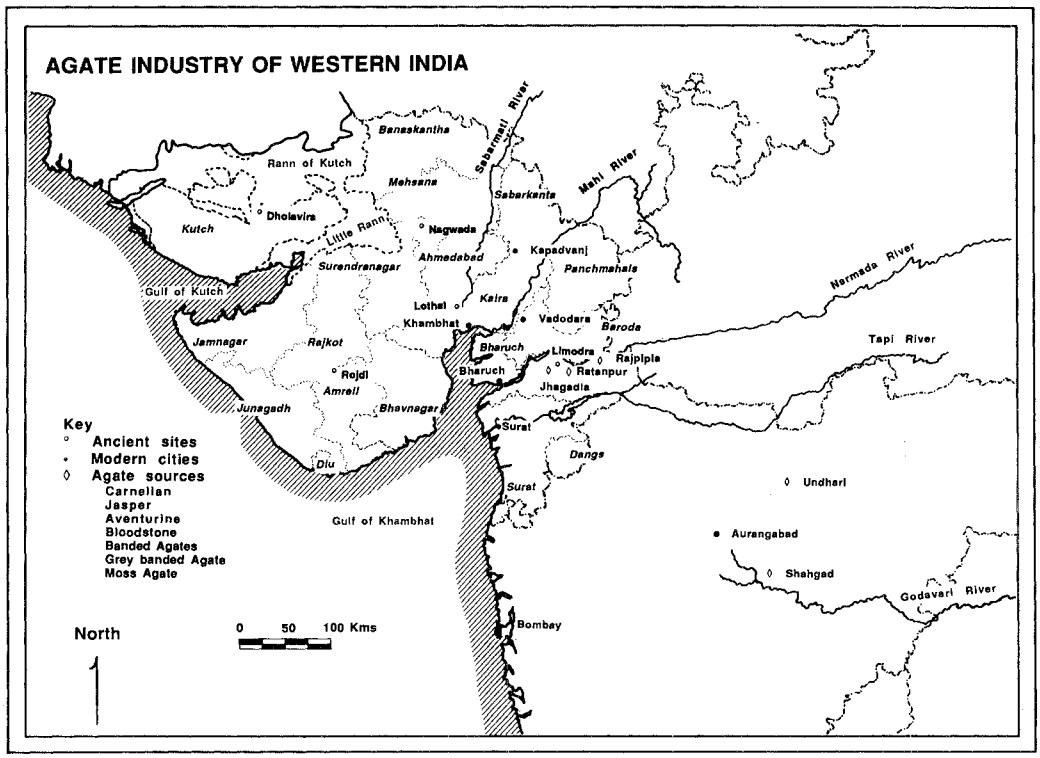

Figure 1 Agate industry of western India.

industry, the project began with many different goals and many different strategies for collecting information, but the main objectives was to correlate dynamic and complex socio-economic relationships with specific archaeological patterns. Although the spatial and quantitative analysis of the ethnoarchaeological data is still under way, this paper will present some of our preliminary results.

Craft specialization: definitions and implications

Before looking at the specific context of agate beadmaking in Khambhat, it is important to examine some theoretical concepts and clarify the usage of important terms.

Generally speaking, the term 'craft specialization' has been used to refer to occupational specialization associated with the development of stratified social organization in pre-state and early state-level societies (Childe 1950). Objects produced by craft specialists were thought to be important for supporting the state and therefore production was closely monitored and generally standardized. In Mesopotamia and Egypt, literary and iconographic sources unequivocally show how the ruling groups of the early cities exerted a direct control on some aspects of production (Adams 1966; Barocas 1978; Liverani 1988: 108–200; Oppenheim 1964: 95–109; Silver 1985; Tyumenev 1956). A similar situation has been observed in other regions of the world, including the Shang cities in north China (Chang 1968: 185–228; Chang 1980) and the Late Classic period in Mesoamerica (Rice 1987).

Although there are some references to craft specialists in the Upper Palaeolithic (e.g. Conkey 1985: 311–15), most scholars associate craft specialization with highly ranked or stratified societies. Therefore, in its operational usage, craft specialization has come to be conceived of as a *state of being* that is achieved in the course of technological and social evolution.

This concept is inappropriate. In all societies, the need for objects or tools made from specific raw materials requires the development of new technologies and individuals capable of producing such objects efficiently. However, not all humans have the same degree of dexterity or skill and available raw materials are themselves quite variable. Consequently, the ability to produce specific objects using specialized technologies is the result of a wide range of processes that are closely tied to the available raw materials, the current technologies, and the overall economic and social adaptations. From this perspective craft specialization should be defined as an adaptive process (Rice 1984: 46–7).

As an adaptive process, specialization in one form or another has been practised in all societies and is not limited to highly ranked or stratified societies. Theoretically, an individual who could no longer participate in specific subsistence activities could still survive by providing important services through the production of special status objects or tools that require specific skills. Individuals who have progressively increased their competence on a limited range of produced goods, and have developed appropriate motor-habits for manufacturing specific objects, are in fact craft specialists, regardless of the chronological time frame or cultural context.

In order to refine the concept of craft specialization for use in archaeological analysis, some modifications in usage and definitions are required. Instead of craft specialization representing a *state of being* eventually attained by some groups in the course of human evolution, it should be considered as a *continuous adaptive process* that is reflected both diachronically and synchronically. On a synchronic level, specialization is a continuum in the sense that it is constantly diffused by intentional training within a production group or by simple observation. Furthermore, the specific technological knowledge may be shared by other members of the community and this shared knowledge may stimulate the growth of other forms of specialization.

On a diachronic level, craft specialization is a continuum because the tendency to focus on a specific range of manufactured goods results in a dynamic fluctuation between standardization and elaboration. Over time there may be periods of standardization or efficiency interspersed by periods of creativity or extravagance.

The question then does not center on the presence or absence of craft specialists, but rather on the role of craft specialization in the overall social and economic structure of a particular society. While in some societies individual specialists may produce items for personal use or for the extended kin-group, in other societies specialists produce objects primarily for trade or as a service to other individuals or communities. It is the role of craft specialists in non-kin related production that is important for understanding the development of social and economic specialization in stratified societies.

While there are many different degrees and forms of stratification, generally speaking a stratified society is characterized by an institutionalized system of social organization with unequal or controlled access to basic resources. A person or group may belong to a specific

social stratum on the basis of economic, political or religious power, or a combination of all three. In historical and modern South Asia, social stratification has been realized in the form of endogamous social units which are organized hierarchically on the basis of religious power, occupational specialization and economic/political power (Berreman 1983: 241; Karve 1961). However, in the absence of written records, a major method for determining religious or political control is through the indirect evidence of control of production, e.g. craft specialization.

In order to understand better the role of craft specialization in stratified societies archaeologists have begun to develop interpretive models based on the study of archaeological patterning of craft indicators. These studies have been supported by ancient literary accounts and iconographic sources, as well as general ethnographic analogies. Generally speaking, these studies have focused on the identification of manufacturing cycles and segregated areas within settlements where specialized production was undertaken; i.e. activity areas, workshops, industrial quarters (Henrickson 1982; Hoffman and Shaffer 1977; Morris 1974; Tosi et al. 1984, and many others). Based on general assumptions regarding the archaeological formation of segregated and specialized production areas, general models for interpreting the social processes involved in the development and articulation of craft specialization have become prevalent in the literature (Brumfiel 1987; Masson 1981; Rice 1981; Tosi 1984; Wright 1975).

These models emphasize the spatial distribution of production materials in the archaeological record, the elaboration or standardization of finished forms, and the development of relatively complex technologies. One of the common models is reflected in the simplistic equation that segregated production areas and standardization = craft specialization = complex society. Another related model assumes that craft specialization and localized production reflect centralized control of production and distribution (e.g. Feinman 1986; Tosi 1984). And, in an urban context, centralized control of production has been used, along with political organization, information processing and social stratification, as distinguishing factors of state-level organization (Jacobson 1987: 142–4).

Although spatial segregation of craft activities in an urban context could be the result of social stratification and intentional urban organization by a state institution or elite groups, it may simply reflect the need of craft groups to reside in close proximity for optimal use of resources or reciprocal exchange of services. In other contexts the segregation or isolation of craft indicators in the archaeological record could be attributed to site formation processes. For example, discarded or dumped materials, if left undisturbed, necessarily occupy continuous and discrete spaces. The archaeological visibility of these assemblages is much higher in social contexts where the clearing and maintenance of working areas is less intensive and organized (Balista and Vidale 1988).

A slightly different approach has been to establish universal categories or variables that can be compared over time and between regions: for example, subsistence goods and wealth, independent and attached specialists, part-time and full-time specialists, staple and wealth finance, etc. (Brumfiel and Earle 1987: 4–5). While these categories may be important, without written records it would be impossible to identify them on the basis of archaeological patterning. For example, how does one distinguish agricultural produce as a subsistence item from the same produce displayed as a symbol of wealth? Or, how does the patterning of

debitage produced by a part-time craft specialist differ from that of a full-time craft specialist? Similarly, how does one differentiate the craft activities of independent and dependent specialists?

In all of these instances, craft specialization has come to be associated with socio-economic stratification and control of production without a clear understanding of how craft specialization itself is organized in different contexts and how this organization would be reflected in the archaeological record. The general archaeological patterning of manufacturing debris and even the degree of standardization of elaboration of the finished objects may be very similar in different time periods or cultural contexts. For example, the archaeological patterning of material by-products from making chert preforms for Danish Neolithic axes could be similar to the debitage from the production of comparable shaped preforms made by the chert workers in the cities of the Indus Valley. However, the similarities in these two archaeological patterns of specialized crafts would most likely result from the nature of the raw material or depositional processes, rather than specific economical or technological behavior. Furthermore, although the development of craft specialization in different times and cultures might be roughly comparable, any interpretation of the archaeological data should be based strictly on contextual information.

In much of the archaeological literature the correlation of specialized crafts to social organization or stratification is an example of 'leap-frogging' from a general level of assumptions to relatively specific interpretations without the support of detailed stratigraphic and distributional studies (Tringham 1978). This situation derives from the general lack of problem-oriented studies that focus on defining the relationships between occupational specialization, urban segregation of crafts and social stratification.

An important step in correcting this situation is to observe, within living cultural systems, the various cycles of production and the deposition of material evidence that result in the creation of the archaeological record. In order to accomplish this objective it is imperative to understand the technological aspects of crafts such as beadmaking, as well as the diachronic developments in the socio-economic structure of the industry. At the same time, we can observe how structured social relationships affect the nature of these cycles (Binford 1983; Donnan and Clewlow 1974; Kenoyer 1983; Kramer 1982; Rye and Evans 1976; Wulff 1966).

In archaeological contexts, the only direct, material indicators for state or elite control are written records of administrative procedures (primarily taxation) or evidence of spatial segregation of craft workshops within the confines of architectural units associated with walled enclosures of palaces or temples. In the absence of such clear-cut indications for state control (as in the case of the Harappan civilization), we must develop appropriate models to investigate the control production by a limited number of individuals and to develop a ranking of crafts, both in terms of the scale of production and the socio-economic importance for the overall economy. This ranking can be attempted through a careful evaluation of several factors: the raw material availability; the technologies used to produce specific objects; the degree of economic interconnection of a given production cycle with the other industrial cycles; and the patterns of distribution of these commodities among the society in general.

Thus, in contrast to the numerous cautionary tales that emphasize what cannot be interpreted from the incomplete archaeological record, the study of Khambhat beadmaking is an attempt to develop positive interpretive models that will be applicable in the Greater Indus Valley region and beyond.

Khambhat stone beadmaking

Beadmaking was once quite common throughout the subcontinent and flourished in most regions where there were suitable raw materials. At present, however, the town of Khambhat, Gujarat, is the only remaining production center where this industry is still being carried out using traditional techniques (Fig. 1). The general stages of production and organization of the industry have been discussed in numerous publications (Francis 1982; Kenoyer 1986; Possehl 1981; Trivedi 1964), but the important archaeological patterns have been overlooked. In the section below, we will present a brief overview of the sequences of production (Figs 2 and 3) and the major archaeological patterns that have been observed.

Raw materials and source areas

Raw materials used in agate beadmaking are found in the rich geological deposits of Baluchistan and Gujarat. The deposits of Gujarat are particularly important because of the high saturation of iron minerals in the agates, which upon heating produces a deep red-orange carnelian. Mining in Gujarat is controlled by state contractors who usually hire laborers from the local Bhil tribal communities (Kenoyer 1986). During the dry seasons of the pre- and post-monsoon, men, women and children, using simple tools, mine the agates by digging tunnels into the Miocene agate conglomerates of the Babaguru Formation (Gadekar 1978). The nodules are collected at loading points or stockpiled in local villages where the contractors sell them to middlemen or merchants from Khambhat.

At various stages during the mining, sorting and stockpiling, flakes are struck from the nodules to determine the quality of the agate (Fig. 2). This selection process results in discrete scatters of cortex flakes and rejected nodules that are distinguishable archaeologically and could be used to document important activity areas.

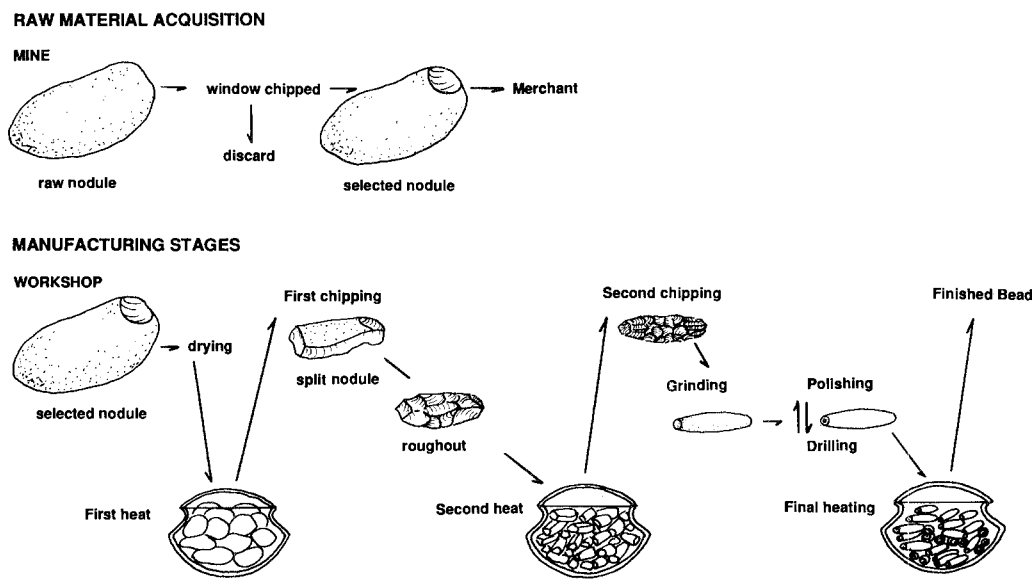

Figure 2 Raw material acquisition and manufacturing stages.

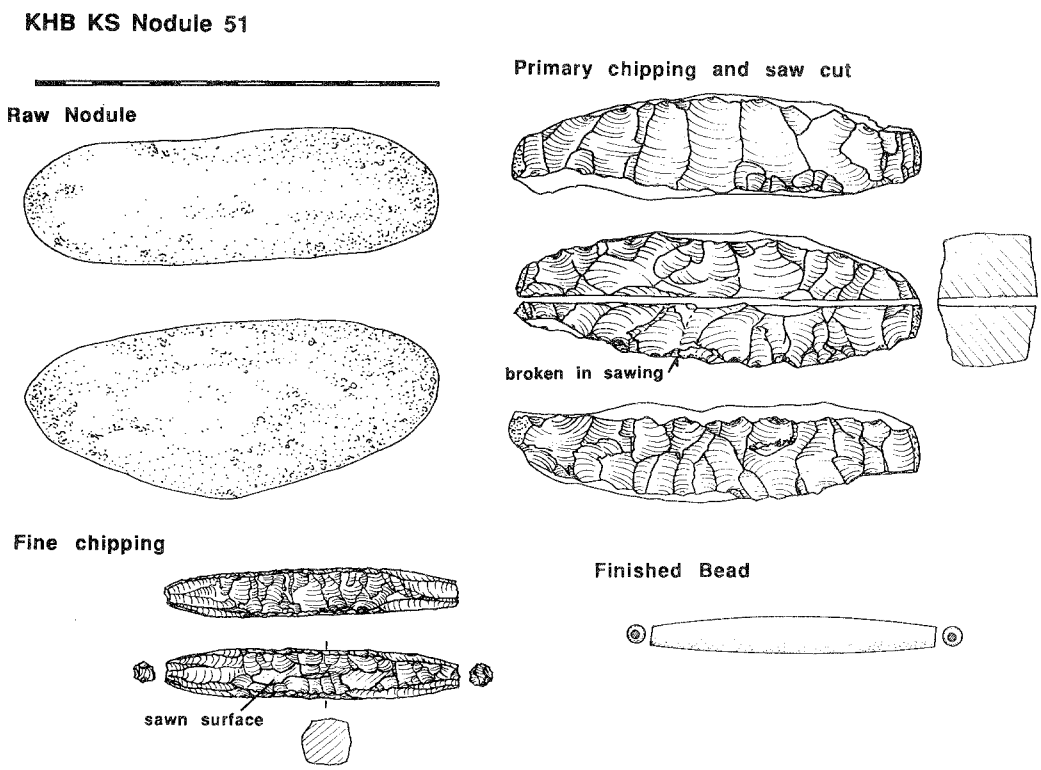

Figure 3 Khambhat, Nodule 51, manufactured in KS workshop.

Drying

After the nodules are brought to Khambhat they are dried in the sun to remove the moisture that is trapped inside the rock. This manufacturing stage is usually carried out for two to three months beginning in March, and large stockpiles of drying nodules are located next to the habitation or workshop of the merchant where they can be easily monitored (Figs 5 and 7). Special quality raw materials are laid out to dry on rooftops or enclosed courtyards where no pilferage is possible. In the context of large-scale production, considerable quantities of lower quality and some potentially good quality raw nodules become scattered and lost in drains, or imbedded in the soil of the courtyard or alley way, and particularly along the edges of the unpaved streets.

Heating

When the nodules have been thoroughly sun dried they are baked in terracotta vessels (Fig. 2) or simple pit kilns to remove any remaining moisture, making the rock more homogeneous and easier to flake. A nodule that is not heated tends to fracture irregularly, while one that has been properly heated can be flaked in a controlled and efficient manner that conserves the valuable raw material. In the larger workshops heating is carried out in permanent kiln structures, while in small-scale workshops temporary kilns are constructed from available broken bricks and rubble.

Through miscalculations of heating and the presence of flaws in the nodules, there is significant breakage during the heating process. Numerous spalled and broken nodules become accumulated in the ash of the kilns, scattered on the floor or ground around the kiln area or around the entrance way to the kilns. The quality of those spalled fragments and their association with more permanent structures can definitely be associated with large-scale production and the long-term stability of the industry.

Chipping

Once the agate nodule has been heated it is chipped into one or more bead roughouts. Chipping or flaking of the nodules is carried out using a technique that is unique to South Asia, called inverse indirect percussion (Kenoyer 1986). A pointed iron stake is stuck in the ground and the nodule is chipped by resting it against the point and striking it with a hammer made of hard wood or buffalo horn. This technique appears to have been developed in prehistoric times. During the Harappan period, before the introduction of iron, a copper stake would have been used, and before the introduction of copper, a stake made of deer antler may have been used (Kenoyer 1983; Clark 1990). Successful experiments have been conducted using both copper and antler stakes.

The scatter of flaking debris resulting from the technique is quite distinctive and, if the flaking area is left undisturbed, it would be identifiable archaeologically (Fig. 4). Typologically the flakes themselves would vary depending on the types of beads being manufactured, but overall patterns of large and small and micro flakes would remain unchanged.

Usually the flaking areas are not left undisturbed because the debitage is recycled to sell to other specialized artisans, or for making smaller beads. The debitage is collected on small mats and dumped in large piles or stored in burlap sacks (Figs 5 and 7). The nature of the recycling and dumping processes results in many important patterns that are visible archaeologically and can be used to distinguish specific types of workshops, as well as primary and secondary dumps. It is not possible to present here the details of the stratigraphic units or the plans of the workshops because meaningful and concise comparisons would require a comprehensive discussion of the total industry. However, preliminary analysis of samples collected from the surface and from excavations reflects different scales of production, variation in production over time, and the quality of finished goods being produced by specific workshops.

Secondary heating

After the nodule has been flaked into a bead roughout and even after it has been finally drilled and polished it is heated several times (Fig. 2). The secondary heating is usually done to change the color of the stone, and in large-scale workshops the heating is carefully monitored by a highly skilled kiln supervisor. Beads are sorted according to color and potential color and then placed in small earthenware pots and covered with ash to protect them from thermal shock. These pots are then placed in the kiln and covered with fuel. Saw dust is used for low heat and dried cow-dung or charcoal is used for high heat. Some beads require seven to ten firings before they achieve the deep red color representative of the highest quality of

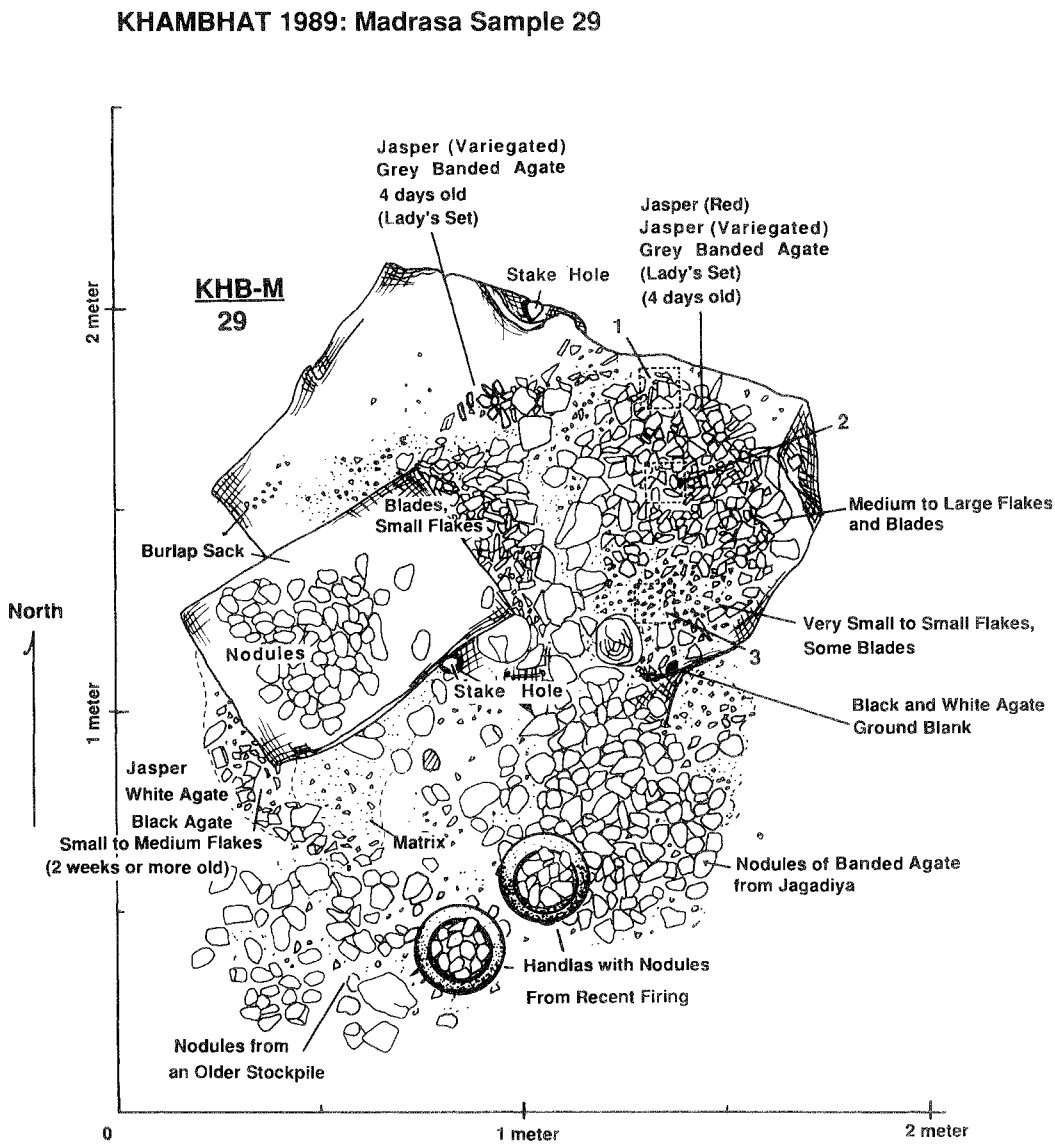

Figure 4 Plan of chipping area, Sample 29.

carnelian. Improper heating can result in wasted fuel and/or cracked beads. Invariably some of the bead roughouts or finished beads do become cracked or spalled, and many of these are lost in the ashes of the kiln. Through the examination of kiln waste it is possible to reconstruct the general scale of production, the quality of the raw materials being processed, and the varieties of finished objects being produced.

Sawing

In order to conserve valuable raw materials large nodules are often sawn before or after the initial chipping (Fig. 3). The traditional method of sawing involved a hand drawn saw with a

copper or iron blade and an abrasive made from emery. This sawing technique has been documented at Harappan sites for making long carnelian beads (Mackay 1943). It takes three to four hours of sawing by hand to cut through a small nodule. Modern sawing is done with electric powered circular blades and, though the process is much faster, there is considerable breakage due to the vibrations of the blade. The sawing process is quite easily documented through the careful examination of flakes that are removed after the nodule is sawn or from actual sawn blocklets.

Grinding

Before the introduction of electrically powered emery wheels the bead roughout was ground and shaped on a hard sandstone or quartzite grinding stone. Different shapes of grinding stones must be used to shape different varieties of beads and they would provide an important archaeological indicator for bead grinding. The dust from bead grinding would also be an important indicator, as long as it was not removed for use as an abrasive in sawing or polishing. Very few ground beads would be lost through hand-grinding techniques, though there would be some breakage due to improper pressure or flaws in the bead roughout.

In the recent past, special grooved stones were used to grind and shape small round beads. The bead was secured in a wooden vise that could be held in both hands, allowing greater pressure to be exerted on the stone. Hand grinding without the use of a vise is very time consuming and experimental studies show that it would take four days to grind a single large biconical bead. If the same size of bead is held in a wooden vise, the grinding process can be completed in approximately four hours. The modern electrically powered emery wheels make it possible to shape the same bead in four or five minutes.

After grinding, the bead blank must be drilled and polished before it becomes a finished bead. In Khambhat, the beads are either drilled first and polished later, or vice versa. The sequence of manufacture depends on the availability of artisans in relation to the current market demand. Modern bead drillers are part-time farmers and do not engage in bead drilling during the farming season. In archaeological contexts, there is evidence for drilling taking place before or after the grinding stage. For some raw materials, such as carnelian, this may have been a necessary sequence of manufacture, with the drilling being done on the larger bead roughout so that the hole could then be used for securing the bead during the delicate grinding process. The tenacity of jasper and other forms of agate do not require this sequence of manufacture and allow a flexibility in production stages that were dependent upon the availability of labor.

Drilling

In Khambhat, the drilling of hard stone such as carnelian and other agates is traditionally done with diamond tipped drills (Kenoyer 1986). Two varieties of diamond tipped drills are used in the drilling of a bead. The *tekni* has a single rounded diamond chip at the tip and is used to make a shallow depression to center the second drill, or *sayedi*. The *sayedi* has two tiny rounded diamonds set at the edges of the tip and is used for the actual perforation process.

The bead to be drilled is held in a wooden vise, and after drilling half way through it is turned over and drilled from the opposite side. Using these two drills, a small bead that is only one centimeter long can be drilled in less than one minute, including the time it takes to turn it over and drill from the opposite side.

The drill tip is cooled by a very ingenious contraption consisting of a small pot filled with water set on a tripod in front of the vise. The pot has a hole in the side and a long wire is set into the hole by wrapping the end with cotton thread. The water in the pot seeps through the thread and runs down the wire to drip on the top of the bead where the drill is turning. This cools the bead and drill, and also helps to wash out the agate powder produced in the drilling process. The water and powder is collected in a bowl beneath the bead and then recycled into the pot that is set on top of the tripod. At the end of the day, the agate powder (*vari*) is removed and stored until sufficient quantities have accumulated. The *vari* is then sold to bead polishers for use in the final stage of polishing.

Very little archaeological evidence is left from the modern bead-drilling process. The miniscule diamond chips are unlikely to be recovered even by water sieving and the powder from drilling is collected and sold to the bead polishers. The only non-perishable objects would be the metal drill bits and the vessels used to hold the cooling water.

Diamonds were not used during earlier prehistoric times; rather beads were drilled using various types of mottled green jasper (Jarrige 1985; Tosi and Piperno 1973; Vidale 1985; Dales and Kenoyer 1990, ms). The Neolithic and Chalcolithic artisans of Baluchistan, and the Greater Indus Valley were familiar with the properties of this stone and were able to drill very long beads with tiny stone drills. Experiments using various qualities of green jasper suggest that drilling was the most time-consuming process of the ancient bead industry. Depending on the specific variety of jasper used for the drill and the nature of the agate itself, it would have taken between two and ten hours to drill one centimeter of agate. This estimate does not include the time required to manufacture and replace broken drills.

Polishing

Polishing of hard agate is a lengthy process that begins with fine grinding using different grades of abrasive. The modern abrasives are usually emery or corundum powder that is mixed with lac (insect resin) and shaped into a wheel. Before the introduction of electricity, the abrasive wheels were turned on a lathe with a bow held in one hand, while the bead was held against the wheel with the other hand. The final polishing was done with fine chalcedony powder or *vari* applied to a wooden polishing disc. Experiments with the lathe wheel-polishing method show that this stage is also very time consuming, taking between three or four hours to polish a single bead. Although there is little or no archaeological accumulation from the polishing process, microfacets on the bead surface can be used to distinguish this method from mass polishing techniques.

In order to polish many beads at one time, artisans in the past developed a polishing technique by which hundreds of beads could be polished at the same time by tumbling in a leather bag with the abrasive powder. Although this process had not been practised in Khambhat for over fifty years, it was possible to recreate the technique experimentally. At the end of fifteen days of tumbling by hand, the beads achieved a low lustre polish. Bag-polishing results in a distinctive rounding of drill hole edges and a low lustre polish in the concave flake scars that may not have been totally ground away. Similar patterns have been observed by the authors on beads from the site of Nagra (third century BC) which is located only 6km from Khambhat (Mehta and Shah 1968).

Final heating

After drilling and polishing, carnelian beads are heated numerous times to achieve a deep red-orange color. The heating process is carefully monitored by the kiln supervisor as outlined above. After the final heating, the beads are rubbed with oil-saturated sawdust to obscure any traces of grinding or small cracks and then they are stored in baskets or tin boxes. Eventually most of these beads will be strung in graduated or sorted sizes and qualities. The bead stringing is done by the women in the family or by hired help under the ever watchful eye of the merchant or supervisor. Even when great care is taken to avoid loss, some finished beads do find their way into the archaeological record, especially in the large-scale production contexts of centralized workshops.

Traditional markets

Although there were many agate beadmaking centers in peninsular India in the past, high quality carnelian beads and special objects produced in Khambhat were traded throughout the subcontinent (Janaki 1980; Francis 1982). Other markets outside the peninsular region include the territories of modern Nepal, Tibet, China, Afghanistan, Iran, the Arab countries, Africa, Europe, and the Americas. The specific beads produced in Khambhat can be distinguished from similar beads made in other regions on the basis of the quality of raw material, manufacturing techniques, and specific bead shapes or designs.

The greatest volume of trade is carried out by full-time merchant families who also control the production of the objects. However, there is considerable trade by small-scale entrepreneurs, as well as travelling pilgrims, sadhus and fakirs.

Organization of production

The organization of the production is highly stratified and rigidly controlled by dominant individuals or merchant families. This structuring of the industry appears to be directly related to the complex social stratification of traditional India which is characterized by endogamous castes, occupational specialization and relative levels of ritual purity.

The dominant merchant families in Khambhat include Hindu, Jain and Muslim communities that have established distinct kin networks or alliances with politically powerful individuals or organizations. Through these connections it is possible to control the flow of raw materials, production and distribution of finished commodities. The major merchants produce specific varieties of objects for trade to local and international markets. Although there is considerable competition between these families, over time they have established strong social and economic alliances so that each merchant family has a fairly secure market for which a specific range of objects is produced. There are, of course, fluctuations in style and raw material depending on the market demand, but, due to the large scale of production, these fluctuations generally appear as long-term trends, and result in the establishment of distinctive technologies for the production of standardized commodities.

This evidence suggests that, in the context of bead manufacture, the presence of a standardized commodity which is distributed over a large region or traded to specific distant markets may be a strong indicator of large-scale production in a few centrally controlled

workshops. It is important to note that this conclusion does not hold true for general terracotta pottery production in the subcontinent, which also reveals a considerable amount of standardization and has a wide regional distribution. In contemporary Gujarat, for example, the production of terracotta pottery is wholly decentralized. The noticeable standardization of the products and their occurrence in a large area is the result of widely distributed kin groups of potters who make standardized styles of ceramics for equally widely distributed ethnic groups. In an archaeological context, it would be possible to differentiate large-scale centralized production from decentralized production of ceramics through the analysis of the specific local clays, the variables of firing and production, and a careful analysis of the finished objects.

In Khambhat the major merchant families carefully monitor and control all stages of bead production, and often extend their control to the mining of the raw agate nodules in the district of Ratanpura, some 125km south-east of Khambhat. They employ a large number of specialized artisans involved in different aspects of production. Some stages of production are carried out in centralized workshops (Fig. 5), while other stages are carried out in dispersed localities throughout the city or even in the rural agricultural settlements. The most important

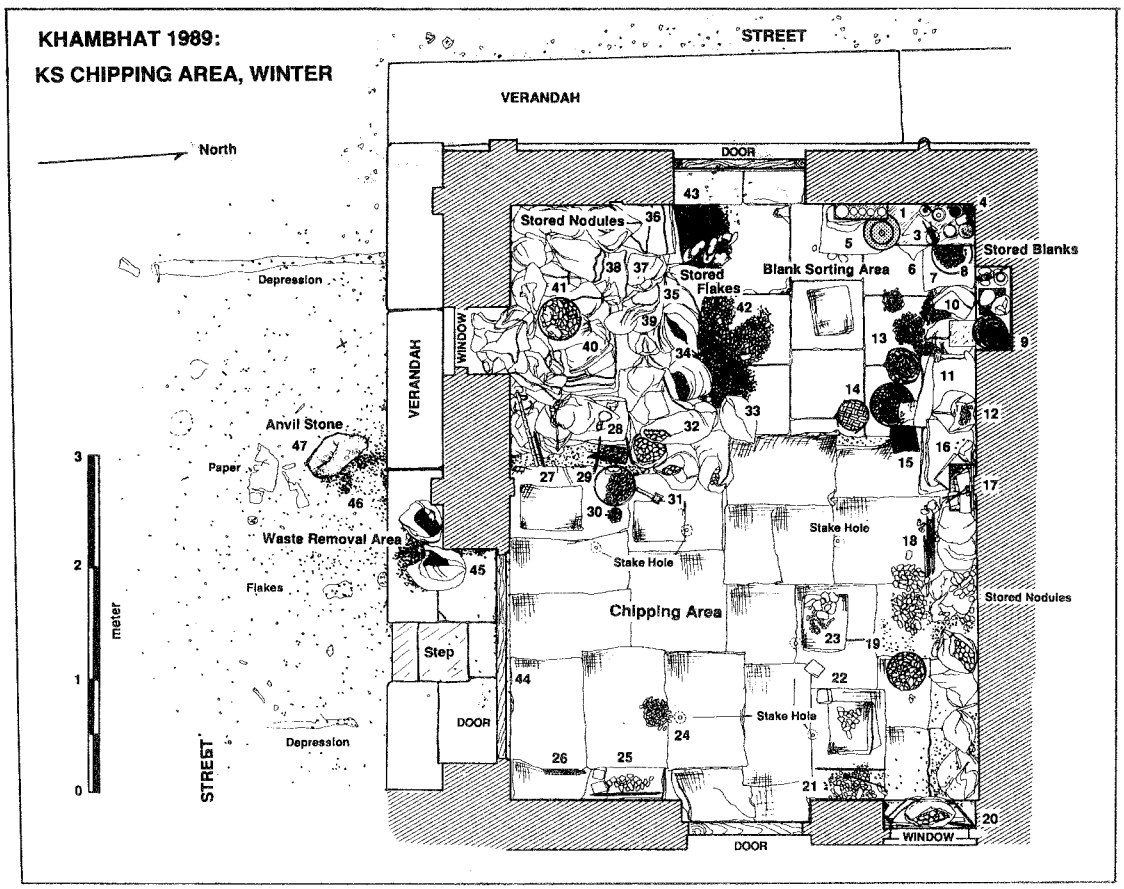

Figure 5 KS Workshop, centralized chipping area, Winter 1989.

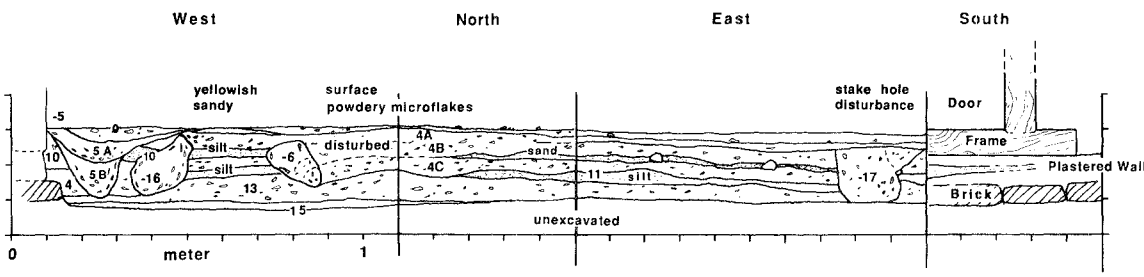

Figure 6 Excavation trench from KS Workshop.

and final stages of production are usually conducted in specific localities under the direct supervision of the merchant group.

The clearest indicator of centralized control is that all of the types of semi-finished items from each stage of production are represented in the archaeological record in or around the merchant's house/workshop (Fig. 6), even though the actual stages of production may be carried out elsewhere. This pattern results from the manner in which these merchants control production, requiring all craftsmen to return the debitage as well as the completed objects. If nodules are chipped into rough bead blanks outside the confines of the centralized workshop, the quality of the original nodules is noted and the nodules are weighed. After chipping, the waste flakes and bead roughouts are returned. The number of bead blanks to waste is observed, and if there is any deviation from the normal ratio of blanks to waste, the artisan is dismissed, or paid a lower rate.

Other stages of manufacture are more easily monitored by counting the number of bead blanks and requiring that all broken fragments are returned along with the finished pieces. This method of administrative control has an important archaeological pattern, i.e. a relatively common occurrence of broken and unfinished beads from all stages of manufacture in the centralized workshop, even though the production itself may have been elsewhere. Correspondingly, the dispersed workshops where the actual chipping, grinding, polishing, or drilling takes place would have only traces of the tiny and microscopic flakes from chipping and the powder or slurry from grinding and polishing. These indicators, along with the remains of various types of tools, would be found in the floors of these dispersed workshops, with only rare occurrences of partially finished items.

Besides the careful stockpiling of lithic debitage destined for different forms of recycling, the large-scale merchants often accumulate large stockpiles of semi-finished bead blanks. The final stages of drilling and polishing depend on the availability of labor and market demand. Since drilling is done by part-time agriculturalists, unpolished or polished beads may be given for drilling, depending on the availability of labor. Semi-finished commodities incorporate not only potential value, but also specialized social relationships, in that the economic transactions needed to change the objects into marketable goods are held in suspension.

The ability of the large-scale merchants to manipulate considerable stocks of unfinished and finished goods contributes to the expression of their political power within the agate-working industrial sector, and within Khambhat society in general. This economic ability is an

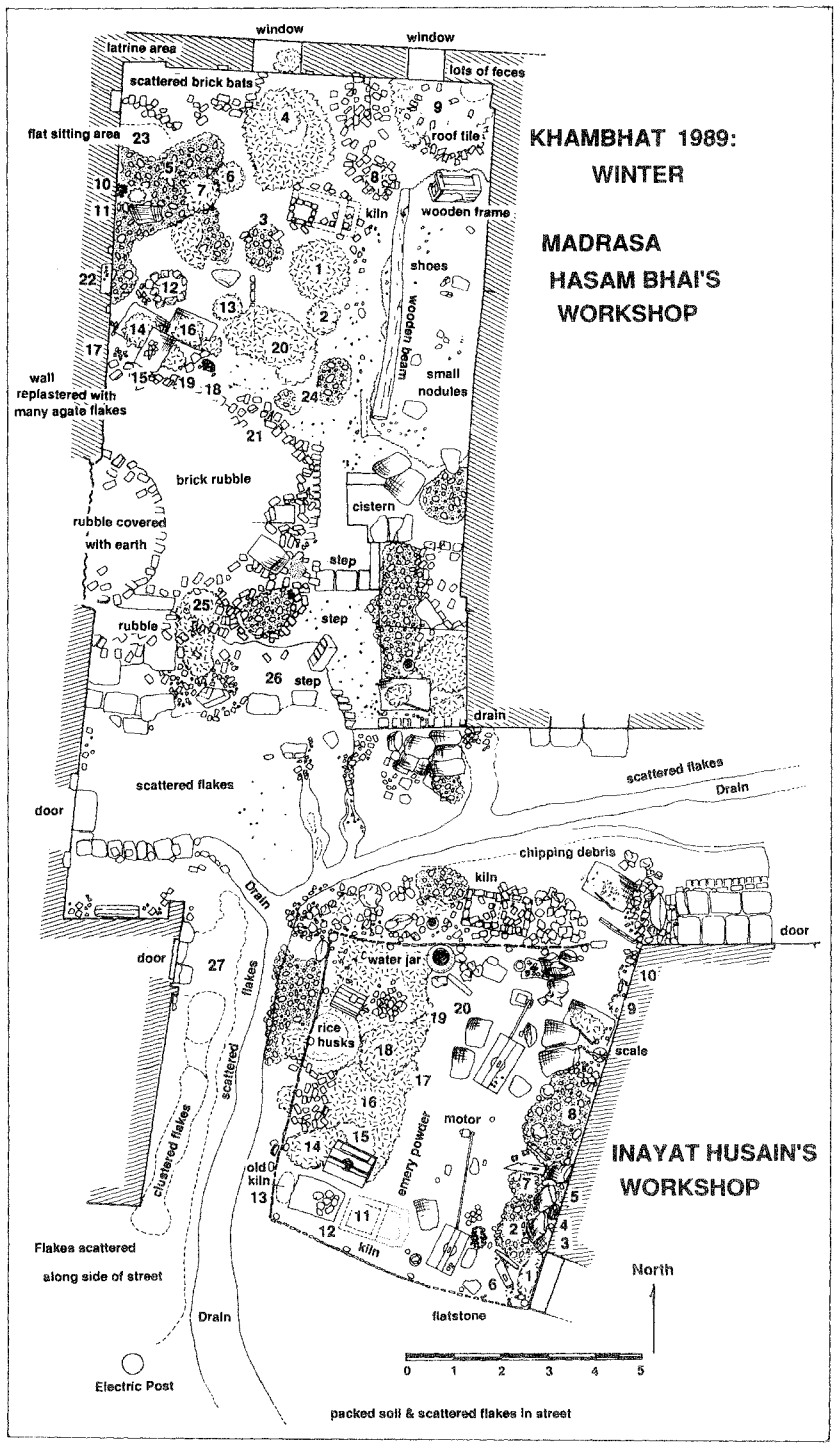

Figure 7 Workshops of two entrepreneurs, Winter 1989.

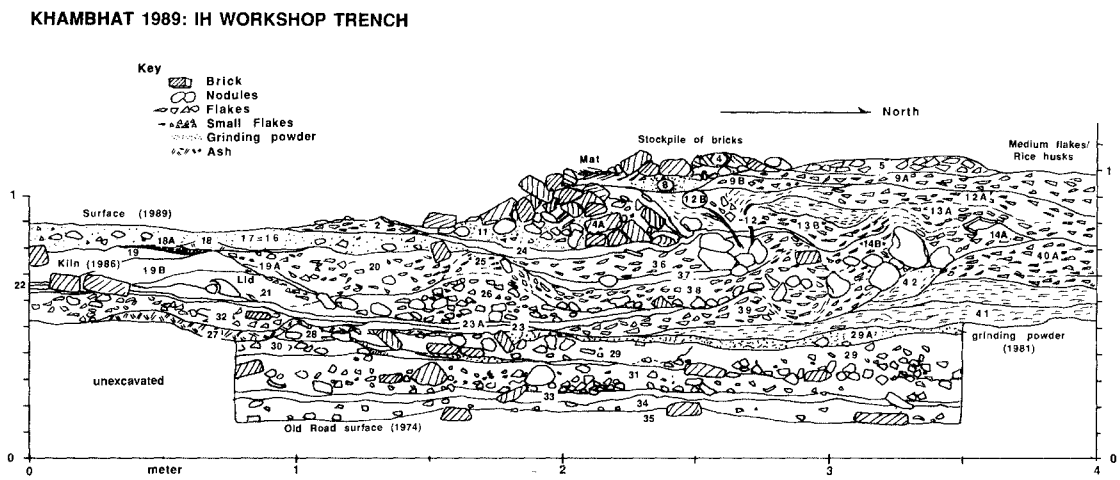

Figure 8 Excavation trench in Inayat Husain's workshop.

indicator of scale of production that differentiates the more established merchants from small-scale entrepreneurs.

One of the interesting recent historical developments in Khambhat is that, with the introduction of mechanical means for grinding, drilling and polishing, the control of production has changed from the control of labor to the availability of cash for acquiring electricity and machines. Anyone with the capital to buy electricity or machines can become a single-family operator, and there are now many small-scale entrepreneurs and part-time specialists who produce limited amounts of goods for sale on an ad hoc basis (Figs. 7 and 8). As recently as fifty years ago, a few powerful families controlled all of the bead polishing process and only ten or twelve families dominated the marketing of beads (Trivedi 1964).

At first glance, the organization and patterning of artifacts in these smaller workshops is generally comparable to the more established workshops. However, the preliminary results of excavations in one such workshop reveal a considerable amount of variation in production over time and a corresponding lack of long-term standardization in the raw materials or the types of artifacts being produced (Fig. 8). The pattern can be attributed to the rapid fluctuations in market demand for different types of objects, and the fact that the smaller entrepreneurs are more susceptible to short-term fluctuations than the more stable, larger workshops. The increasing presence of small-scale entrepreneurs in Khambhat indicates that the present economic organization of bead production allows for both levels of production.

Conclusion

The ultimate objective of the Khambhat bead study is to develop interpretive models for understanding the role of specialized crafts in prehistoric society. Current excavations at numerous sites in South Asia such as Harappa (Dales and Kenoyer 1990), Mehrgarh and Nausharo (Jarrige 1986; 1988), and Dholavira (Bisht 1989) are providing important new data on beadworking and other crafts. It will be important to determine whether these sites had

one or two major workshops, with possible subsidiary artisans working at home, or if the production was carried out by many different workshops throughout the site. The former pattern could be interpreted as representing a centrally controlled industry that was probably important for the state economy, while the latter would reflect a decentralized production by relatively independent entrepreneurs. On the other hand, it may be possible to determine the presence of several levels of production, as is seen in present-day Khambhat. Through the ranking of these and other associated crafts, it may be possible to develop some interpretive models for identifying indirect control of production, even in the absence of written records of taxation or tribute.

At the beginning of our field-work in Khambhat we thought that we knew a great deal about agate working, the organization of the agate industry and specialized crafts in general. But, after months of detailed observation and interviews, it became clear such industries involve many levels of control and a variety of complex social and economic interaction networks with other associated crafts. At times the complexities of the ethnographically observable structure appear to be overwhelming, but, over time, the archaeological record of this complex system does reflect specific patterns that will be helpful in the interpretation of the role of craft technologies in early urban centers.

Acknowledgements

We would like to thank the many artisans and merchants of Khambhat for taking the time to show us their ancient craft.

The Khambhat Project has been jointly directed by Dr J. Mark Kenoyer (University of Wisconsin, Madison, USA.) with Dr Kuldeep K. Bhan (Maharaja Sayajirao University, Baroda, India) and Dr Massimo Vidale (Istituto Italiano per il Medio ed Estremo Oriente (IsMEO), Rome, Italy). Special thanks go to Dr K. T. M. Hegde, Chairman of the Maharaja Sayajirao University, Baroda, for providing laboratory facilities and advice. Several students were involved in various stages of the project, from field-research to analysis of the samples: Seetha Reddy, Paul Robbins and Lisa Ferin (University of Wisconsin, Madison), Alessandro Vanzetti (University of Rome, Italy) and Italo Bettinardi (University of Padua, Italy). We would also like to thank Dr A. Khazanov, Heather Miller, Bill Belcher and Lisa Ferin for comments and suggestions on the paper itself.

The field-research has been supported primarily by a grant to J. M. Kenoyer from the Smithsonian Institution, supplemented by a National Science Foundation, Presidential Young Investigator Award. K. K. Bhan has been supported through the Department of Archaeology and Ancient History, Maharaja Sayajirao University, Baroda, and M. Vidale through a grant from the IsMEO, Rome.

31.xi.90

Jonathan Mark Kenoyer
Department of Antropology
University of Wisconsin
Madison, USA

Massimo Vidale
Istituto Italiano per il Medio ed Estremo Oriente
Rome, Italy

Kuldeep Kumar Bhan
Department of Anthropology and Ancient History
Maharaja Sayajirao University
Baroda, India

References

Adams, R. M. 1966 *The Evolution of Urban Society*. Chicago: Aldine.

Arkell, A. J. 1936. Cambay and the bead trade. *Antiquity* 10: 292–305.

Balista, C. and Vidale, M. 1988. Towards a geo-archaeology of craft at Mohenjo Daro. In *Interim Reports*, 3 (ed. Giovani Leonardi). Aachen: RWTH-IsMEO, pp. 93–108.

Barocas, C. 1978. *L'Antico Egitto*. Roma: Newton Compton.

Berreman, G. D. 1983. The evolutionary status of caste in peasant India. In *Social Anthropology of Peasantry* (ed. Joan P. Mercher). Bombay: Somaiya, pp. 237–50.

Binford, L. R. 1983. *Working at Archaeology*. New York: Academic Press.

Bisht, R. S. 1989. A new model of the Harappan town planning as revealed at Dholavira in Kutch: a surface study of its plan and architecture. In *History and Archaeology* (ed. B. Chatterjee). New Delhi: Ramanand Vidhya Bhawan, pp. 397–408.

Brumfiel, E. M. and Earle, T. K. 1987. Specialization, exchange and complex societies: an introduction. In *Specialization, Exchange and Complex Societies* (eds E. M. Brumfiel and T. K. Earle). Cambridge: Cambridge University Press, pp. 1–9.

Chang, K. C. 1968. *The Archaeology of Ancient China*. New Haven, CN: Yale University Press.

Chang, K. C. 1980. *Shang Civilization*. New Haven, CN: Yale University Press.

Childe, V. G. 1950. The urban revolution. *Town Planning Review*, 21: 3–17.

Clark, J. Desmond 1990. Why Change? An example of the technology from India's enduring past. *Sankalia Memorial Volume, Deccan College Bulletin*, 49: 83–98.

Conkey, M. W. 1985. Ritual communications, social elaboration and the variable trajectories of Paleolithic material culture. In *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity* (eds T. D. Price and J. A. Brown). New York: Academic Press, pp. 299–323.

Dales, G. F. and Kenoyer, J. M. 1990. Preliminary report on the third season of work at Harappa, Pakistan. *Pakistan Archaeology*, 23 (forthcoming).

Dales, G. F. and Kenoyer, J. M. 1990. Preliminary report of the fifth season at Harappa, Pakistan. University of California, Berkeley and University of Wisconsin, Madison. Manuscipt.

Donnan, C. B. and Clewlow, Jr, C. W. 1974. *Ethnoarchaeology*. Institute of Archaeology Monograph IV. Los Angeles: University of California Press.

Feinman, G. 1986. The emergence of specialized ceramic production of formative Oaxaca. In *Economic Aspects of Prehistoric Highland Mexico* (ed. Barry Issac). Greenwich, CN: JAI Press, pp. 347–73.

Francis, P. J. 1982. *Indian Agate Beads*. The World of Beads Monograph Series. Lake Placid, NY: Lapis Route Books.

Gadekar, D. R. 1978. Some aspects of stratigraphic and sedimentologic investigations of the Neogene Oligomict conglomerates near Jagadia, Dist. Brooch, Gujarat and their genesis. *National Geographic Journal*, 24(4): 163–8.

Hegde, K. T. M., Sonawane, V. H., Shah, D. R., Bhan, K. K., Ajitprasad Krishnan, and Pratapa Chardnan, S. 1988. Excavation at Nagwada – 1986 and 1987: a preliminary report. *Man and Environment*, 12: 55–65.

Henrickson, E. F. 1982. Functional analysis of elite residences in the Late Early Dynastic of the Diyala Region: House D and the walled quarter at Kafaja and the 'palaces' at Tell Asmar. *Mesopotamia*, XVII: 5–33.

Hoffman, M. A. and Shaffer, J. G. 1977. The Harappan settlement at Allahdino: analyzing the sociology of an archaeological site. In *Ecological Backgrounds of South Asian Prehistory* (eds K. A. R. Kennedy and G. Possehl). Ithaca, NY: Cornell University Press, pp. 94–117.

Jacobson, J. 1987. The Harappan civilization: an early state. In *Studies in the Archaeology of India and Pakistan* (ed. J. Jacobson). New Delhi: Oxford and IBH, pp. 137–74.

Janaki, V. A. 1980. The commerce of Cambay from the earliest period to the nineteenth century. *Geography Series*, 10. Baroda: Maharaja Sayajirao University.

Jarrige, J.-F. 1985. Continuity and change in the North Kachi Plain (Baluchistan, Pakistan) at the beginning of the second millennium BC. In *South Asian Archaeology 1983* (eds J. Schotsmans and M. Taddei). Naples: Ist. Orientale, pp. 35–68.

Jarrige, J.-F. 1986. Excavations at Mehrgarh-Nausharo. *Pakistan Archaeology*, 10–22: 62–131.

Jarrige, J. F. 1988. Excavations at Nausharo. *Pakistan Archaeology*, 23: 149–203.

Karve, I. 1961. *Hindu Society – An Interpretation*. Poona: Deccan College.

Kenoyer, J. M. 1983. Shell working industries of the Indus civilization: an archaeological and ethnographic perspective. Doctoral dissertation. Department of South and Southeast Asian Studies, University of California, Berkeley.

Kenoyer, J. M. 1986. The Indus bead industry: contributions to bead technology. *Ornament*, 10(1): 18–23.

Kenoyer, J. M. 1989. Socio-economic structures of the Indus civilization as reflected in specialized crafts and the question of ritual segregation. In *Old Problems and New Perspectives in the Archaeology of South Asia* (ed. J. M. Kenoyer). Madison, WI: Wisconsin Archaeological Reports 2, pp. 183–192.

Kramer, C. 1982. *Village Ethnoarchaeology*. New York: Academic Press.

Liverani, M. 1988. *Antico Oriente, Storia, Societa, Economica*. Roma: Editori Laterza.

Mackay, E. J. H. 1943. Chanhu-Daro excavations 1935–36. *American Oriental Society*, 20. Boston: Boston Museum of Fine Arts.

Masson, V. M. 1981. Urban centers of early class society. In *The Bronze Age Civilization of Central Asia* (ed. P. Kohl): Armonk, NY: M. E. Sharpe, Inc., pp. 135–48.

Mehta, R. N. and Shah, D. R. 1968. *Excavations at Nagara*. Baroda: Maharaja Sayajirao University.

Morris, C. 1974. Reconstructing patterns of non-agricultural production in the Inca economy: archaeology and documents of institutional analysis. In *Reconstructing Complex Societies* (ed. C. B. Moore). Supplement to the *Bulletin of the American Schools of Oriental Research*, 40: 49–68.

Oppenheim, A. L. 1964. *Ancient Mesopotamia*. Chicago: University of Chicago Press.

Possehl, G. L. 1981. Cambay beadmaking: an ancient craft in modern India. *Expedition*, 23(4): 39–47.

Rao, S. R. 1973. *Lothal and the Indus Civilization*. Bombay: Asia Publishing House.

Rice, P. M. 1981, Evolution of specialized pottery production: a trial model. *Current Anthropology*, 22(3): 219–40.

Rice, P. M. 1984. The archaeological study of specialized pottery production: some aspects of method and theory. In *Pots and Potters* (ed. P. M. Rice). Los Angeles: University of California, Institute of Archaeology Monograph XXIV, pp. 45–54.

Rice, P. M. 1987. Economic change in the lowland Maya Late Classic period. In *Specialization, Exchange and Complex Societies* (eds E. M. Brumfiel and T. K. Earle). Cambridge: Cambridge University Press, pp. 76–85.

Rye, O. S. and Evans, C. 1976. Traditional pottery techniques of Pakistan. *Smithsonian Contributions to Anthropology*, 21. Washington, DC: Smithsonian Institution Press.

Silver, M. 1985. *Economic Structures of the Ancient Near East*. London: Croom Helm.

Sinopoli, C. M. and Blurton, T. R. 1986. Modern Pottery Production in Rural Karnataka. *Dimensions of Indian Art* (eds L. Chandra and J. Jain). New Delhi: Agam Kala Prakashan, pp. 439–56.

Tosi, M. 1984. The notion of craft specialization and its representation in the archaeological record of early state in the Turanian Basin. In *Marxist Perspectives in Archaeology* (ed. M. Spriggs). Cambridge: Academic Press, pp. 22–52.

Tosi, M., Bondioli, L. and Vidale, M. 1984. Craft activity areas and surface survey at Mohenjodaro. *Interim Reports*, 1. Aachen: RWTH-IsMEO, pp. 9–37.

Tosi, M. and Piperno, M. 1973. Lithic technology behind the ancient lapis trade. *Expedition* 16(1): 15–23.

Tringham, R. 1978. Experimentation, ethnoarchaeology and the leapfrogs in archaeological methodology. In *Explorations in Ethnoarchaeology* (ed. R. Gould). Albuquerque: University of New Mexico Press, pp. 169–99.

Trivedi, R. K. 1964. *Agate Industry of Cambay*. Census of India, 5, part 7-A. Delhi: Govt of India.

Tyumenev, A. I. 1956. The state economy of ancient Sumer. In *Ancient Mesopotamia* (ed. I. M. Diakanoff). Moscow, pp. 70–87.

Vidale, M. 1985. Some aspects of lapidary craft at Mohenjodaro: in the light of the surface record of the Moneer South East Area. *Interim Reports*, 2. Aachen: RWTH-IsMEO, pp. 113–50.

Vidale, M. 1989. Specialized producers and urban elites: on the role of craft industries in Mature Harappan urban contexts. In *Old Problems and New Perspectives in the Archaeology of South Asia*, (ed. J. M. Kenoyer). Madison, WI: Wisconsin Archaeological Reports 2, pp. 171–82.

Wright, H. T. and Johnson G. A. 1975. Population, exchange and early state formation in southwestern Iran. *American Anthropologist*, 77: 267–89.

Wulff, H. E. 1966. *The Traditional Crafts of Persia*. Boston: MIT Press.

Abstract

Kenoyer, Jonathan Mark, Vidale, Massimo and Bhan, Kuldeep Kumar

Contemporary stone beadmaking in Khambhat, India: patterns of craft specialization and organization of production as reflected in the archaeological record

Archaeologists studying early urban societies have long used the concept of craft specialization as an important indicator of social stratification, centralized control of production and indirectly, state level organization. However, new interpretive models need to be developed in order to understand socio-economic developments in the prehistoric period. The stone beadmaking industry of Khambhat, India, provides a modern example of a traditional specialized craft that is practised by different communities within a highly stratified society. Furthermore, there is a considerable degree of centralized control in production and various levels of state control are present. Preliminary results of the ethnoarchaeological and experimental studies of the stone bead industry in Khambhat are used to examine the concept of craft specialization and to suggest new ways of applying this concept to prehistoric studies.