CHEVRON AND MILLEFIORIE IN INDIA

by
Alok Kumar Kanungo
Archaeological Sciences Centre, IIT Gandhinagar

ABSTRACT

Kaca di India wujud dalam bentuk manik wound monochrome *pada zaman Chalcolithic di Maski, dan sebagai manik dan gelang dari penghujung tempoh pertindihan fasa Tamadun Harappa dan budaya besi* Painted Grey Ware *di Bhagwanpura. Kepelbagaian dan pengedaran manik meningkat berlipat kali ganda dalam fasa Sejarah Awal. Rekod literatur yang bertarikh dari 1200 BCE sehingga sekitar 300 BCE merujuk kepada manik kaca sebagai barang mewah untuk golongan kelas atasan. Walau bagaimanapun, tidak seperti tablet tanah liat di Asia Barat, maklumat mengenai kaedah pembuatan kaca di India purba adalah terhad; sama ada hanya sebagai maklumat material sisa arkeologi ataupun rekod epigrafi. Walau bagaimanapun, kita mempunyai rekod sastera merujuk kepada penggunaan dan penghasilan pelbagai jenis manik kaca dan objek lain dalam bentuk* Yajurveda *(1200 BCE),* Brahmanas *(800-600 BCE),* Sutras *(600-400 BCE),* Arthasastra *(300 BCE),* Puranas, *(400-1400 CE) kepada* Ain-i-Akbari *(rekod mahkamah pemerintahan Akbar, yang ditulis oleh Abul Fazal, sekitar 1590). Rekod kolonial yang bermula pada abad ke-19 memberikan gambaran terperinci mengenai pembuatan kaca asli dan pengerjaannya di India. Walau bagaimanapun tiada tiada sebarang maklumat di dalam dokumen tersebut merujuk kepada* millefiorie. *Ahli-ahli arkeologi mendakwa menjumpai manik serta mangkuk* millefiorie *di India sejak abad ke-1 CE. Data etnografi mendedahkan bahawa pengeluaran moden* chevron *dan* millefiori *bermula di bandar kaca tradisional India, iaitu, Purdilnagar pada tahun 1970-an. Sejurus itu, ia telah dihasilkan dalam relau manual tanpa menggunakan sebarang acuan. Walaupun* millefiorie *telah menjadi sinonim dengan Venice, namun pada masa ini,* millefiorie *di Venice dihasilkan tanpa penggunaan mana-mana relau tradisional atau teknik asal. Kertas kajian ini merekodkan proses pembuatan* millefiori *seperti yang diamalkan di Purdilnagar sebagai model untuk menafsirkan penemuan arkeologi yang berkaitan.*

Glass in India in the form of wound monochrome beads, are known from the Chalcolithic Period at Maski, and as beads and bangles from the overlap phase of the Late Harappa and Painted Grey Ware in Bhagwanpura. Their variety and distribution increased many folds in the Early Historic phase. The literary record dating from 1200 BCE till about 300 BCE defines glass beads as a luxury item meant for the higher class of the society. However, unlike the clay tablets in West Asia, there is limited information about the method of glass making and working in ancient India, either as archaeological remnants or epigraphical records. However, we do have literary records referring to the use and production of variety of glass beads and other objects in the form of *Yajurveda* (1200 BCE), *Brahmanas* (800-600 BCE), *Sutras* (600-400 BCE), *Arthasastra* (300 BCE), *Puranas*, (400-1400 CE) to *Ain-i-Akbari* (a court record of Akbar's reign, written by Abul Fazal in c. 1590). Colonial records dating to the 19th century provide detailed description of the native glass making and working in India. However, none of these documents refer to millefiori. Archaeologists have claimed to find millefiori beads and bowls in India dating back to 1st century CE. Ethnographic data reveal that in modern period chevron and millefiori production started at the traditional glass town of India, i.e., Purdilnagar in 1970s. Then on, it has been produced in a manual furnace without use of any moulds. Though millefiori has become synonymous with Venice, but in present Venice, millefiori is produced without the usage of any traditional furnace or the original technique. This paper records the process of making millefiori as practiced in Purdilnagar as a model for interpreting associated archaeological findings.

INTRODUCTION

Glass in India, in the form of wound monochrome beads are known from the Chalcolithic Period at Maski and as beads and bangles from Late Harappa and Painted Grey Ware overlap phase in Bhagwanpura. Their variety and distribution increased many folds in the Early Historic phase (Kanungo 2004a, 2008, 2014, 2016). The literary record dating to 1200 BCE till about 300 BCE defines glass beads as a luxury item meant for the higher class of the society (Kanungo 2008). However, unlike the clay tablets in West Asia, there is little information about the method of glass making and working in ancient India either as archaeological remnants or epigraphical records. However, we do have literary records referring to the use and production of variety of glass beads and other objects in the form of *Yajurveda* (1200 BCE), *Brahmanas* (800-600 BCE), *Sutras* (600-400 BCE), *Arthasastra* (300 BCE), *Puranas*, (400-1400 CE) to *Ain-i-Akbari* (a court record of Akbar's reign, written by Abul Fazal in c. 1590) (Kanungo 2008).

The colonial records (Halifax 1892; Dobbs 1895; Mukherjee 1895 and an anonymous record of 1895) dating to the 19th century provide detailed description of the native glass making and working in India. However none of these documents refer to millefiorie. Archaeologists have claimed to find millefiorie beads and bowls in India dating back to 1st century CE. Ethnographic data reveal that in modern period chevron and millefiori production started at the traditional glass town of India, i.e., Purdilnagar in 1970s. Then on, it has been produced in a manual furnace without use of any moulds. Though millefiorie has become synonymous with Venice, but at present in Venice millefiorie is produced without the usage of any traditional furnace or the original technique. This paper records the process of making millefiori as practiced in Purdilnagar as a model for interpreting associated archaeological findings.

Beads

Beads are small, colourful, usually standardized, inexpensive and often quite beautiful. They can be arranged in almost endless configurations. Bead is universal, and is one of the oldest artistic form of human expression. They can and have been made from virtually any solid material (Francis 1982a). They have been worn in strings or necklaces, which was the common mode of ornamentation known from very ancient times. What interest more is the variety of their shapes, mode of decoration and the different material employed in their manufacture (Margabandhu 1971: 764).

The study of ancient Indian glass beads has received very scanty attention because accurately dated specimens are comparatively few and are inadequately published.

Glass Bead Production Methods

Different methods of manufacturing beads have been discussed by Lamb (1965), Sleen (1973), Lugay (1974), Francis (1983, 1990a, 1990b, 1993), Kucukerman (1987), Liu (1989), Ross and Pflanz (1989), Bronson (1990), Karklins and Jordan (1990), Basa (1993), Karklins (1993), Kock and Sode (1995), Kanungo (2001a, 2001b, 2004a, 2004b, 2006, 2014, 2016), Carroll and Allen (2004) and Holland and Holland (2006). Since 5th century BCE glass beads were made at different places in South Asia using indigenous techniques and India has been the leading glass bead makers. However, the millefiorie production method using traditional manual method has not been recorded in entirety.

Traditional Glass Bead Production in India

Traditionally glass beads are produced in India at two different locations, using two entirely different techniques. These are at: 1) Papanaidupet, Andhra Pradesh (drawing method); and 2) the cluster of villages at Purdilnagar-Jalesar-Akrabad-Hasayan in western Uttar Pradesh (furnace-winding and manual pulling/drawing method). These production places have not only been producing beads for local use but for export throughout the world since Early Historic time (Francis 2002; Kanungo 2001a, 2004a, 2006, 2014, 2016). They have mastered the art of innovation by the trial and error method and have adopted new designs as per the market demands.

Decorating the monochrome beads with applied threads or eye motif, powder-glass, gold/silver foiled, transparent coated designed glass, silk printing, matt finish by applying hydrofluoric acids and the respective traditional furnaces used for the above mentioned designs at Purdilnagar is discussed at length in author's earlier publications (Kanungo 2004a, 2004b, 2006, 2014).

Antiquity of Millefiorie

The manufacture of mosaic beads can be traced to ancient Roman, Phoenician and Alexandrian times. Millefiorie beads have been uncovered from digs at Sandby borg, Öland, Sweden, dating to late 5th and early 6th century. A piece of millefiorie was found, along with unworked garments, in a purse at the early 7th century Anglo-Saxon burial site at Sutton Hoo. Millefiorie glass beads from Italy have been found at the 8th century archaeological sites in Ireland. Rhodes, the Levant, and the city of Rome have also been suggested as centres of production (cited in Francis 2002: 94).

Nomenclature: Mosaic / Murrine / Chevron / Millefiorie

Millefiori (a thousand flowers) is a glasswork technique which produces distinctive decorative patterns on beads and glassware (fig. 1). The term millefiori is a combination of the Italian words «mille" (thousand) and "fiori" (flowers) and is a variety of Venetian mosaic glass. Francis (2002: 236) preferred this to be termed as mosaic glass and canes to be as fancy canes (Francis 1982b: 15).

Reference to mosaic beads in the context of Asian maritime bead trade around the 1st century is meagre. They have been found at the four emporia-Arikamedu, Mantai, Khlong Thom, and Oc Eo. There is also a simple type at Kausambi in North India. A mosaic face bead with a design of a duck on the opposite side was found in a 6th century royal tomb in Korea (Francis 2002: 94). Bohingamuwa (2017: 269) found two suspected Mosaic cane beads from the surface at Mantai. He opines those are not Chevron and/or Millefiori beads (personal communication).

Due to varying nomenclatures many a time there is an overlap in identifying or interpreting mosaic, murrine, chevron and millefiorie varieties. There is a slight difference between chevron/murrine canes and mosaic/millefiorie patterns. Likewise, the production process and design of chevron (*rosetta* in Italian) and millefiorie are varied. Chevrons are drawn glass beads made with layers of different-coloured glass, each (except the outer layer which is smooth) with cogwheel or starburst shape in cross section (fig. 2). When their ends are bevelled, the layers appear as a series of chevrons, hence their English name (fig. 3). Most were made in Venice. The earliest ones usually had seven layers, the inner would be 'bottle green' glass and then succeeded by white, blue, white, red, white, and blue layers. The edges were faceted to reveal the designs. The earliest chevron beads were made towards the end of the 15th century, consisting of seven layers of alternating colours. They usually have six facets. The process of manufacturing these beads have not changed ever since the technique was introduced however, moulds for star patterns is a later addition.

The millefiorie technique involves the making of beads and other glass products (bowls, pots, table-wares and others) using chevron discs. Murrine is a multi-coloured pattern that can be seen only from the cut ends of the cane.

Evidences from Indian sub-continent

In the Indian sub-continent although more than 300 archaeological sites have revealed evidences of glass and glass beads but only a few have reported millefiorie beads. Five millefiorie beads are reported from the Kushana level and one from the Gupta level at Sonkh (Peach 1993: 298–302). Millefiorie was also found from the Early Historic level of Mahasthan in Bangladesh (Boussac and Alam 2001) as well as Deulpota in West Bengal (Chakraborty 2000). A few identical beads were also found at Kopia; glass working area of the site is dated to 1st century CE. (fig. 4) (Kanungo 2013: 356). All

the above mentioned specimens are flat collar shaped beads and are green in colour with dark red, black, yellow and white ladder type design. This leads to the question whether they were produced at one place and traded to different places. Only the beads found at Kopia have been scientifically analysed and its trace elements are published (Dussubieux and Kanungo 2013). With analyses of other finds the pertinent question of provenances can be answered. However, all these finds need closer examination as, in most cases, these are application of mosaic pattern on the body of the beads rather than chevron in section or millefiori in design.

An artefact found in 1945 was reported by French excavator Jean-Marie Casal in 1947-48 from the site of Arikamedu was later mentioned in Dikshit (1969: 51) as a small mosaic tablet of millefiori glass having a floral device in the centre with an ornamental border (Fig. 5). The artefact is relatively dated to 1st c. CE, on the basis of morphological similarity to the well-known Venetian millefiorie.

M.G. Dikshit (1969: 29) reported about 1st c. CE fragment of bowls from the site of Sirkap and Ratta Pind in Pakistan. Ratta Pind is located close to Taxila. He described the Sirkap specimen as being made by employing glasses of different colours and shapes for the even thickness of the walls and thus producing a mosaic. The Ratta Pind specimen comprises several flowers with a cellular structure surrounded by black points picked up in several colours.

Process of Making Millefiorie

The first step in making millefiori beads is to mould the rods or canes in a pattern. The patterned cane is also known as murrine. The murrine looks plain on the outside, but when the inside is exposed, a detailed flower pattern is revealed. In some cases, a star pattern and a pattern of geometric shapes is also seen. No two patterns are symmetrically alike which proves they were handmade and not with the help of mould or casting or carving

With the introduction of moulds the murrine or chevron glass is made following:

- The desired base colour is melted and a globule is made from the same.

- The globule is taken at the end of a steel pole of about 1.5 metre and is dipped into different crucibles of different colours of molten glass. By this process the sphere grows in size.

- Then, the glass sphere is pushed in different pattern moulds (fig. 6).

- Once the required pattern is achieved, another layer of glass is added to give the mass a cylindrical form and to make the mass's exterior round and shiny.

  This happens because the application of different layer of glass and repeated shaping of the same leaves the mass with an embossed finish.

- Another steel pole of about 1.5 metre is attached to the other end of the glass pattern and both poles are pulled to the required diameter without tampering the cross sectional design.

  This process needs a lot of skills, experience and patience.

These canes are not perforated, rather they are sliced thin and used to decorate beads, bangles, bowls, pots and different table wares. These final products are known as millefiorie designed.

Purdilnagar: Indian Centre of Traditional Glass Windings

In the field of bead studies, furnace-wound glass beads have become synonymous to the villages of Purdilnagar or Purdalpur, primarily because of the mass-scale export-quality bead production taking place in this village for centuries.

In Purdilnagar, 200 furnaces (*bhatti*) were active till 2007 which produced beads, joint-less bangles and, minor objects of glass. With wide scale circulation of Chinese replicas, which are comparatively cheaper and better glazed, 150 furnaces have closed down their business, thus leaving only 50 furnaces that are functional today. The demand for beads have gone down drastically of late. Today, one finds glass beads and bangles production ratio to be 15:85%. There used to be more than a dozen villages in the vicinity where glass works were the primary economy. However, right from the beginning of the 21st century, many villages have abandoned this craft one after another. The last three villages besides Purdilnagar where the crafts

are still practised on a limited scale are Jalesar (seven furnaces), Hasayan (twenty-two furnaces) and Akrabad (twelve furnaces) (fig. 7). The first two villages produce only cattle beads, locally known as *chalu* beads, meant for animals and the last village produce only bangles.

Although there has never been any attempt to know the archaeology of glass works at these places, Purdilnagar locals believe that this craft has been flourishing there for the last 500 years.

Chevron Cane/Tube Production in Purdilnagar

For more than half a century, a few artisans at Purdilnagar have practised the art of making chevron/murrine canes. Either they produce chevron beads out of these canes or after slicing the discs from these canes they make designed millefiorie beads, bangles and other objects like bowls and fountain pot.

To make millefiorie beads it is first necessary to make a chevron/murrine glass cane of the desired pattern, often in the form of rings, stars or flowers. The finished cane is cut to short pieces or sticks between 5 mm. and 1 cm. long.

There are two ways of making millefiorie beads. One way is to place the chevron/murrine sticks on an iron plate. The sticks are placed on one end so that the pattern at the other end faces upwards. The iron plate is put just outside the working port so that the sticks are heated up (fig. 8). Then a small quantity of glass is caught on the pontil from inside the furnace and is shaped into a narrow oblong bead that is then rolled across the sticks so that the end-pieces stick firmly on to the bead. The bead and the mosaic sticks are then melted together in the furnace with the bead being given its final shape with the form-iron. This technique leaves the finished millefiorie patterns sitting on the outside of a core of monochrome glass.

The second method of making millefiorie beads is by firstly placing discs of the chevron/murine canes in a pre-determined pattern on a kaolin (Rajmahal clay) tile. The discs are brought to a required malleable state by placing the tile near the working port. Secondly semi molten glass is taken on a pontil and rolled over the chevron discs so that they get fixed in the required pattern. Thirdly the designed core is again placed inside the furnace for the chevron discs to get embedded and give it a millefiorie look.

Then the finishing is done by rolling the millefiorie over the rail grid with simultaneous use of form iron (fig. 9).

Case Studies

At present, Chevron glass canes and tubes are being produced at Purdilnagar only at two furnaces, i.e., Heider Ali Glass Furnace (27° 39' 28.38" N; 78° 22' 13.30" E) and Mahammad Hasain Glass furnace (27° 39' 23.76" N, 78° 22' 23.88" E) (fig. 10). Their products are sold as chevron beads and millefiorie products in south and south-east Asia and Africa. As the entire process in Venice has become mechanised and changed to mould pressed, often the Indian handmade chevron and millefiorie are passed off as fake antique Venetian pieces.

Gas Fuelled Furnace

Hasain Bhai has been making chevron beads and millefiorie discs for beads and other by-products since 1990. He learned rather up scaled the art from his brother-in-law, Heider Ali whose family has been producing such canes for half a decade.

Hasain Bhai's furnace, which is the only gas fuelled furnace in Purdilnagar, is one of its kind (custom made by himself). It is made of clay and square in ground plan (fig. 11). One side has an opaque wall, opposite to which there is a single main working port for marvering the glass (fig. 12). The other two sides have three working ports, each having an independent hanging crucible. All six crucibles carry independent colour glasses (fig. 13). Since this is a gas fuelled furnace, there is no ash pit. The mode of fuel is domestic gas cylinder but to raise the pressure, an unsafe method is practised. The cylinder is kept in a wide mouth basin filled with hot water; this is placed at the outer wall of the furnace hall . Hot water is poured in the basin at regular interval, which helps in raising the pressure of the fire at the furnace (fig. 14). The entire act of producing chevron canes or tubes is carried out by only one master craftsman, i.e., Hasain Bhai, with the help of a junior artisan.

On a steel pipe, Hasain Bhai picks up a white colour glass and blows through mouth to give a cylindrical shape to the glass (if it was to produce canes and not tube, then the blow is not required but making parison) (fig. 15). By picking different colour glass from different crucibles on individual

rods, parisons are made and applied all around the cylindrical glass mass (fig. 16). Each time, a stripe of glass is applied on the cylinder by Hasain Bhai, the helper takes the entire lot and put it in the main single port for proper fusing. Hasain Bhai then gives the stripe a conical shape using a heavy mallet/trowel (fig. 17). Once the stripes are properly fused and the star shape is obtained, the in-between invert triangles are filled with another colour of glass or the white base colour and the entire mass is again given a cylinder shape. Such process is repeated layer after layer to obtain the required pattern. Finally the entire mass of glass is coated with either one of the colours used or altogether a different colour. The entire mass is brought to a raised iron plated platform with 10% slanting position. Hasain Bhai elongates the cylinder by rolling the mass over the platform with intermittent use of a big mallet (fig. 18), blowing the glass mass and repeatedly (fig. 19) heating the entire mass in the furnace for maintaining the required semi molten stage. He also uses the quenching method in between by inserting the mass in a water container and sprinkling the water on the joint of glass and steel rod (fig. 20). While rolling the glass mass on the iron platform, the other end of the iron pipe is rested on a cloth instead of any stone or brick or floor, as Hasain Bhai needs to give air blow through mouth at regular interval and he does not want dust to get inside the glass because of the air blow. Whenever air bubble comes on the glass mass, he breaks that part with a mallet (fig. 21).

Once the mass is made, the helper brings a *cheetah/salia* (a pointed thin rod) and puts it in the pipe mounted with the chevron glass mass (this is not required if the end product is cane). The master craftsman then pushes the salia at the centre of the chevron through the pipe to make the required perforation (fig. 22). It requires craftsmanship and time management to repeatedly apply various colours on the cylinder and yet maintain the pattern and perforation through the cylinder. In the process, the craftsman keeps moving to all three sides of the furnace repeatedly in preparing the chevron mass.

In the meantime, the helper winds a small amount of glass on a mandrel and keeps it adjacent to the main working port in a semi-molten stage. Hasain Bhai brings the perforated chevron mass for one last time to the furnace to make the mass malleable enough and attaches the mandrel with little amount of glass at the other end of the chevron mass. When the glass joins properly, holding the pipe at one hand and mandrel with the other, he pulls the mass a bit longer (fig. 23) and moves to the attaché room that has an iron hook fixed to the ground at one end. At about three metre from there, there

are wooden planks on the floor at a regular interval (fig. 24). Handing over one pole to the helper who places the centre portion of the mass against the hook, the two craftsmen start walking back for six to seven metre distance (by keeping that distance, they achieve the required diameter of the chevron pattern) while holding the respective pole in their hands (fig. 25). When the glass on the pipe loses its malleability, the craftsmen break the glass pipes. Hasain Bhai brings both the steel pipes with the remaining glass back to furnace and after giving the required heat pulls the other end to the required diameter with the help of a tong (fig. 26).

The drawn pipes/canes are broken to the length of rectangular tin annealing boxes. The craftsmen put several pieces of these pipes in the box, which is filled with annealing cotton (fig. 27). Hasain Bhai keeps the annealing tin boxes with canes on a custom-made stand above the furnace. The craftsmen then start the next batch of production, and when the pipes for next batch are ready in a new annealing box, the old box is pushed a bit further, little far from the central heating point of the furnace (fig. 28). In a day, seven to eight batches are thus produced. Proper annealing takes about eight hours, before the chevron pipes are ready to be packed for dispatch.

The flow of work is as follows: Breaking the glass → Putting glass in crucibles → Melting of glass → Gob formation → Parison preparation → Reheating → Applying different colour glass till the required millefiori design is achieved with reheating with each application of glass → Blowing → Reheating → Attaching a rod at other end → Drawing the glass tube → Cutting → Annealing → Sorting → Packing → Dispatching.

Wood Fuelled Furnace

In the other hand at a walking distance of les then 500 m in the same village, Heider Bhai still uses wood fuelled furnace for half a decade for the same chevron canes. The art of chevron and then millefiorie was mastered and then innovated by him (in childhood) in 1970s by the art of trial and error. His interest was caught by a millefiorie bead brought to him by a businessman, who had bought it in Venice. He duplicated similar chevron canes as used in the Venetian millefiorie bead at a wood fuel furnace in village Hasayan (his wife's village). At present he continues to practice the production of millefiorie in Purdilnagar at a furnace which is similar to any traditional bead furnace but half of its size.

The process of making chevron and drawing the cane is same as described in the section dealing with gas fuelled furnace.

The Heider Bhai's furnace is entirely made of clay and circular in shape with nine working ports (fig. 29). The furnace is built on a brick lined 5.5 feet deep underground upturned V shaped ash pit (fig. 30), which gives access for great quantities of air and which renders it possible to undertake precise firing using the thick and dry brushwood. The nail triangular shape forms the opening of the ash pit and is the receptacle for the fuel which is placed on an iron mesh (fig. 31). Brick nodules are placed on the mesh and they act as heat retainers. The pit performs two function one as an ash receptacle, two providing vent/passage for constant oxygen flow for the fuel to continuously burn.

A number of rectangular, sun-dried clay plates are placed standing upright around the pit that is used to serve as the base of the fire-chamber. The number of plates shows how many colours can be worked on. The circumference of the furnace is bounded with a line of mud bricks at the ground level.

A clay dome is made by building over the clay plates. The top is covered with a clay plate. This plate is lifted for regular change of crucibles. The furnace is made of coarsely tempered clay mixed with chopped straw. This practice of adding fine chopped straw to strengthen the 'poor', 'lean' or sandy clay has been an ancient technique (Singh 1989: 187). When the furnace is fired, the straw burns off, leaving a highly porous clay furnace that can cope with the great range of temperatures between the day's high working temperature and the night's cooling off. Four Y-shaped wooden poles are placed close to the furnace in a square layout to dry the wood over it for the next day's fuel.

The opening from which glass is picked is called the window and just inside it there is a small open crucible for the glass to be worked with, which measures about 25 × 40 cm and is made of clay mixed with chopped straw (fig. 32). It is also necessary to change the crucibles continually, because a crucible will normally be burnt after about two weeks. When crucibles are replaced or the structure is repaired, the outside of the old furnace is built again with new, straw-tempered clay. In normal circumstances, the furnace can be used for about six months, depending entirely on how carefully it is built and maintained. After demolishing the used furnace at the same place the new furnace is created. This results in an abundance of fired clay debris with glass spilling, clay plates, broken crucibles with a glass layer

and bricks and other debitage littered around the glass-works (fig. 33).

The number of working ports of the furnace are kept open based on the number of colours being used for the millefiorie canes. While recording only four coloured millefiorie canes were being made so only four ports were being used, other five were sealed with mud bricks and plastered.

Observation

Over the centuries both Heider and Hasain families had become masters of multi-coloured cane making. It was natural for both to adopt the art of chevron making which is an advanced form of multi-coloured glass rods; first it was Heider Bhai and then Hasain Bhai who mastered the art of millefiorie making based on the skills they had inherited from their fore fathers.

Purdilnagar has an established trade network of exporting glass beads and bangles for centuries. This connect probably aided in monopolizing the chevron and millefiorie market for south and south-east Asia and Africa within a span of 50 years (fig. 34).

It is interesting to observe that leftover debitage of chevrons are more abundant at production place and in the surrounding area in comparison to that of the debitage of the monochrome canes which are also produced in the same village. This is for the fact that chevron leftover canes which are mostly the last attached portion to the drawing pipe, has less recycle value due to use of multi coloured glass (Fig. 35).

A feature which would have been difficult to visualise in archaeological context is that the depth and style of the pit helps generating and maintaining the temperature to keep the glass in required malleable stage as comparatively thicker and larger parison is required for Chevron making than what is required in case of making glass beads or bangles The entire mass of glass with layers of different coloured glass can also be worked upon. This perhaps contributes to our ancient Indian knowledge system in the field of pyro technology and furnace making.

Caution needs to be exercised while describing a find as chevron/murrine cane and or mosaic/millefiorie patterned or beads made out of these. Mosaic in not Millefiorie. Assumptions of similarity have probably led many early finds to have been termed as millefiorie. Millefiorie in true sense requires

multiple pieces flower design (cross - section) in an artefact. By employing chevron discs in millefiorie making, it could have taken the shape of a specialised craft. However, prior to that if at all millefiorie was produced each flower must have been done manually and in a very limited scale..

Acknowledgement

The author is grateful to the Indian National Trust for Art and Cultural Heritage (INTACH) for the Research Grant (Indian Citizen) 2015-16; Mr. Ashok Gupta, for his good offices and contacts for the local hospitality in the field; Dr. Shahida Ansari for her perseverance; Dr. Krishna Pal Singh and Mr. Narayan Paliwal for assistance in field; Dr. Oishi Roy for proof reading; Dr. Trupti More for archival help; Dr. Sharmi Chakraborty for facilitating the picture of Deulpota bead; Dr. Sharada Channarayapatna for help with map; and Mr. Hatim Sham for help with visuals. Heartfelt thanks to the master chevron craftsmen Hasain and Heider Bhais of Purdilnagar for their readiness to provide ethnographic information and their interest in the work. Special thanks to Raju and Abrar Bhai, the bead merchants of Purdilnagar and Sikandarao who used their familiarity with the craftsmen for facilitating this research work.

References

Anonymous 1895. *Industrial Monograph on Pottery and Glassware in Central Provinces*. Bombay.

Basa, K.K. 1993. Manufacturing Methods of Monochrome Glass Beads in South Asia, *Man and Envi*ronment 18(1): 93-100.

Bohingamuwa, W. 2017. *Sri Lanka and the Indian Ocean Contacts: Internal Networks and External Connections*. Unpublished Ph.D. Dissertation. Oxford: University of Oxford.

Boussac, Marie-Francoise and Alam, Md. Shafikul. 2001. Beads, in *France-Bangladesh joint Venture Excavations at Mahasthan: First Interim Report 1993-1999* (Md. Shafikul Alam and Jean-Francois Salles Eds.), pp. 427-495. Dhaka: Department of Archaeology, Ministry of Cultural Affairs, Government of the People's Republic of Bangladesh and Mission Francaise de cooperation archaeologique au Bangladesh, Maison de I'Orient Mediterraneen- Jean Pouilloux, Lyon, Ministry of Foreign Affairs, France.

Bronson, B. 1990. Glass and beads at Khuan Lukpad, southern Thailand, in *Southeast Asian Archaeology 1986* (I.C. Glover and E. Glover Eds.), pp. 213-229. Oxford: BAR International Series.

Carroll, B.H. and J.D. Allen 2004. Bead Making at Murano and Venice, *Beads* 16: 17-37.

Chakraborty, S. 2000. *Chandraketugarh: an Archaeological and Cultural Study (500BC to 500AD)*, unpublished Ph.D. Dissertation. Pune: Deccan College Post Graduate & Research Institute.

Dikshit, M.G. 1969. *History of Indian Glass*. Bombay: University of Bombay.

Dobbs, H.R.C. 1895. *A Monograph on the Pottery and Glass Industries of the North-Western Provinces and Oudh*. Allahabad: North-western Provinces and the Oudh Government Press.

Dussubieux, L. and A.K. Kanungo 20013. Trace Element Analysis of Glass from Kopia, in *Glass in Ancient India: Excavations at Kopia*, pp. 360-366. Triruvananthapuram: Kerala Council for Historical Research.

Francis, P. 1982a. *A Handbook of Bead Materials*. New York: Lapis Route.

Francis, P. 1982b. *The Glass Beads of India*. New York: Lapis Route Books. The World of Beads Monograph Series 7.

Francis, P. 1983. Some Thoughts on Glass Bead Making, in *Proceeding of the 1982 Glass Trade Bead Seminar*, pp. 193-202. New York: Rochester Museum and Science Center, Rochester, Research Notes16.

Francis, P. 1990a. Glass beads in Asia, part I, Introduction, *Asian Perspectives* 28(1): 1-21.

Francis, P. 1990b. Glass Beads in Asia, part II, Indo-Pacific beads, *Asian Perspectives* 29(1): 1-23.

Francis, P. 1993. West African Powder Glass Beads, *Ornament* 16(4): 96-97, 100-101.

Francis, P. 2002. *Asia's Maritime Bead Trade, 300 BC to the Present*. Honolulu: University of Hawai.

Halifax, C.J. 1892. *Monograph on Pottery and Glass Industries of the Punjab, 1890-91*. London.

Holland, S. and T. Holland 2006. Folded Glass Beads: An Islamic Innovation, *Ornament* 29(4): 34-37.

Kanungo, A.K. 2001a. Glass Beads in Indian Archaeology: An Ethnoarchaeological Approach, *Deccan College Post Graduate & Research Institute Bulletin* 60-61: 337-353.

Kanungo, A.K. 2001b. Glass Beads in India: Lamp Winding & Moulding Techniques, *Man and Environment* 26(2): 99-108.

Kanungo, A.K. 2004a. *Glass Beads in Ancient India: An Ethnoarchaeological Approach*. Oxford: British Archaeological Reports International Series 1242.

Kanungo, A.K. 2004b. Glass Beads in Ancient India and Furnace-Wound Beads at Purdalpur: An Ethnoarchaeological Approach, *Asian Perspective* 43(1): 123-150.

Kanungo, A.K. 2006. Glass Bead Production Centres: An Ethnoarchaeological Assessment, in *Past and Present Ethnoarchaeology in India* (G. Sengupta, S. Roychoudhury and S. Som Eds.), pp. 411-27. New Delhi: Pragati Publishers & Kolkota: CASTEI, India.

Kanungo, A.K. 2008. Glass in India, *Encyclopaedia of the History of Science, Technology and Medicine in Non-western Cultures*, Alpha – G, Part 7 (H. Selin Ed.), pp. 1023-1033. Netherlands: Springer.

Kanungo, A.K. 2013. Glass Beads & Bangles from Kopia, in *Glass in Ancient India: Excavations at Kopia*, pp. 331-343. Triruvananthapuram: Kerala Council for Historical Research.

Kanungo, A.K. 2014. *Indian Glass Beads: Archaeology to Ethnography*. New Delhi: Research India Press.

Kanungo, A.K. 2016. *Mapping Indo-Pacific Beads vis-à-vis Papanaidupet*. New Delhi / Madrid: Aryan Books International / International Commission on Glass.

Karklins, K. 1993. The *A Speo* Method of Heat Rounding Drawn Glass Beads and its Archaeological Manifestations, *Beads: Journal of Society of Bead Researchers* 5: 27-36.

Karklins, K. and D. Jordan 1990. An Early 19th-Century Account of Beadmaking in Murano and Venice, *The Bead Forum* 17: 5-8.

Kock, J. and T. Sode 1995. *Glass, Glass Beads and Glassmakers in Northern India*. Vanlose: THOT Print.

Lamb, A. 1965. Some observations on stone and glass beads in early southeast Asia, *Journal of the Malaysian Branch of the Royal Asiatic Society* 38(2): 87-124.

Liu, R.K. 1989. Mosaic Face Beads, *Ornament* 12(3): 22-23.

Lugay, J.B. 1974 Determination of the methods of manufacture of glass beads, in *Proceedings of the First Regional Seminar on Southeast Asian History and Archaeology*, Manila, 1972, pp. 148–181. Manila: National Museum of the Philippines.

Margabandhu, C. 1971. *Material Culture of Central and Western India and the Deccan from circa the third century B.C. to the third century A.D. Based on the Evidence of Excavated Remains*. Unpublished Ph.D. Dissertation. Nagpur: Nagpur University.

Mukharji, T.N. 1895. *A Monograph on the Pottery and Glassware in Bengal*. Calcutta.

Peach, H.J. 1993. Beads, in *Excavations at Sonkh 2500 years of a Town in Mathura District* (H. Hartel Ed.), pp. 298-302. Berlin: Dietrich relmer verlag.

Ross, L.A. and B. Pflanz 1989. Bohemian Glass Beadmaking: Translation and Discussion of a 1913 German Technical Article, *Beads* 1: 81-94.

Singh, R.N. 1989. *Ancient Indian Glass: Archaeology and Technology*. Delhi: Parimal Publication.

Sleen, W.G.N. van der 1973. *A Handbook on Beads*. Liege: Librarie Halbert.

CAPTIONS FOR ILLUSTRATIONS IN PLATE V AND PLATE VI

Fig. 1 : A millefiorie paper weight

Fig. 2 : Purdilnagar Chevron canes

Fig. 3 : Chevron bead string

Fig. 4 : a. Beads with ladder patterned design from Sonkh (*after* Peach 1993: 301), b. Mahasthan (*after* Boussac and Alam 2001: 474), c. Deulpota (*courtesy* Directorate of Archaeology and Museum, West Bengal) and d-e. Kopia.

PLATE V

Fig.1

Fig.2

Fig.3

Fig.5

Fig.4

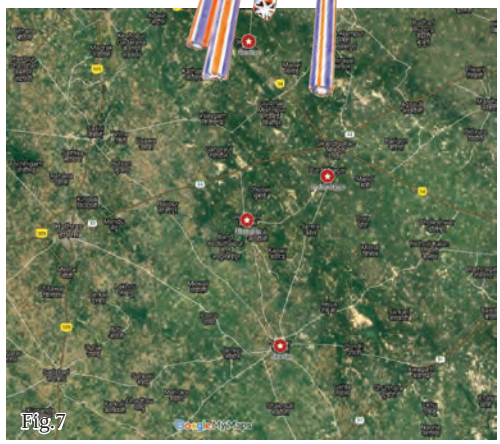

Fig.7

Fig.10

Fig.6

Fig.8

Fig.9

Fig.11

Fig.12

Fig.13

Fig.14

Fig.15

Fig.16

Fig.17

PLATE VI


Fig.18


Fig.19


Fig.20


Fig.21


Fig.22


Fig.23


Fig.24


Fig.25


Fig.26


Fig.27


Fig.28


Fig.29

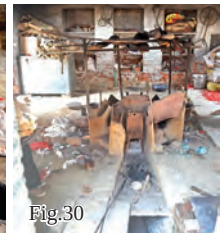
Fig.30


Fig.31

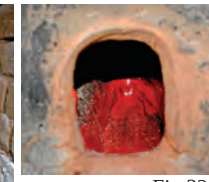
Fig.32


Fig.33


Fig.34


Fig.35