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Neo-Chalcolithic Culture of Chirand: Approaches of Making Bone and Antler Tools

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"Chirand is the rising Sun of the Neolithic Culture of India"

—F.R. Allchin

Abstract: *The excavation at Chirand, District Saran, Bihar, have thrown a new light on the Indian neolithic culture. It is significant to note that so far all neolithic site in India have been located on hill-tops or on foot-hills but for the first time, a full-fledge neolithic culture has been discovered in the middle Gangetic basin. The amazing discovery of the Neolithic bone artefacts at Chirand has provided ample material to the archaeologists for the study of the primitive of the bone tool making and assesses the maturity of the vision of the people who manufactured them. It is fascinating to know as to how the people managed the various needs of their daily life with the boon tools. The present work attempts to make out the techniques followed in their manufacture, their probable uses and the various vocations practised by the Neo-Chalcolithic or early village farming community.*

Keywords: *Antler, Bone, Celt, Techniques, Tools*

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Introduction

The important Neo-Chalocolithic sites reported in the mid-Gangetic region are Chirand (on the bank of River Ghaghra, Saran), Taradih (Bodhgaya), Senuwar (near Sasaram), Checher, Manghi, Sonpurand Panr (Samastiput Dist.) in Bihar. Among these Chirandmay be taken as a representative site. It has revealed cultural material belonging to the Neolithic, Chalcolithic and Iron Age phases. The beginning of the Neolithic culture here dated from 2500 BC to 1600 BC.Chirand (25^0 45'N, $84^0$50'E) is situated on the confluence of the rivers Sarayu and Ganga in the Saran district of Bihar **(Fig. 1& 2).** Chirand is a well known excavated site in the north Bihar plain revealing a continuous sequence from the 'Neolithic'/Neo-Chalcolithic to the historical periods (Narain 1970-71: 1-35, Sinha 1994).The site of Chirand in Bihar was excavated by the Directorate of Archaeology and Museums, Bihar and revealed five broad cultural

period beginning with Neolithic tillthe late historical period.The Neolithic remains at Chirand are found in a 4.5 m thick cultural deposit. Period - I is divided into two sub-periods- IA and IB. These sub periods have yielded ground polished stone tools in association with other cultural assemblages. These ground/ polished tools include axes, celts, stone hammers or pounders, rubbing stones, milling stones, querns and pestles along with some fragments of axes. Other artefacts include bone and antler tools and microliths in large numbers, beads and pendants of semi-precious stones and terracotta objects.

The excellent bone tools types include hammers, needles, points, stylus, tanged and socketed arrow-heads, 'burnishers', scrapers, drills, tongs, adzes, bodkins and shaft-straighteners. According to the excavators, the microliths characterized by parallel side blades, scrapers, arrowheads, serrated points, notched blades, points, lunates, borersand a few geometric microliths generally made of chalcedony, chert, agate, jasper, etc. were also a part of neolithic complex. The potteries are either handmade or made with the help of wheel. There is predominance of red ware and lesser frequency of grey, black and black-and-red wares in this period (IAR 1962-63: 6, IAR 1963-64: 69-70: 3-4, IAR 1970-71: 6-7, IAR 1971-72: 6-7, IAR 1980-81: 9-10, Verma 1970-71, 2007, Hazarika 2013: 82).

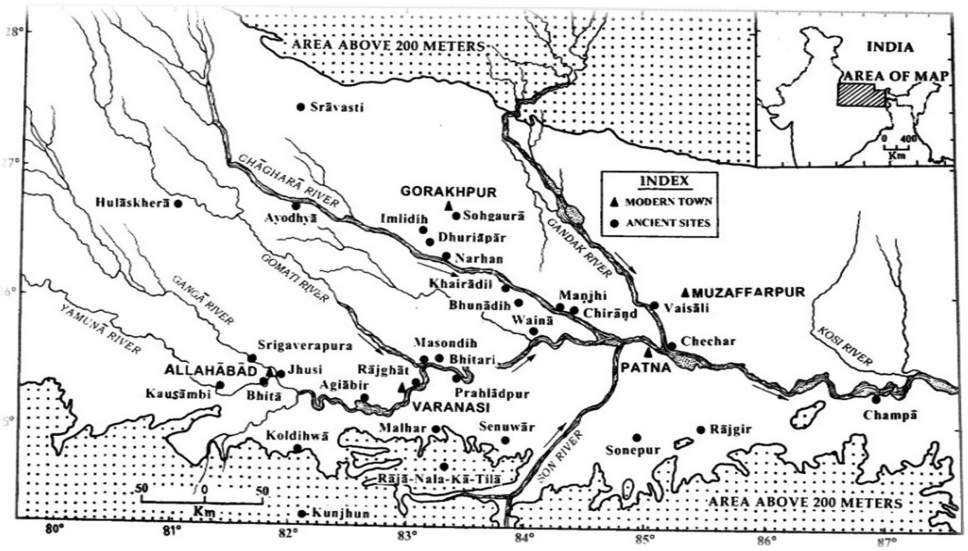

Figure 1: Chirand in Middle Ganga plain

Figure 2: Satellite Map of the Site Chirand (Courtesy: Google)

In India earliest bone tools have been reported in Neolithic content, in stratified excavated sites, A worked bone point like object from the upper Neolithic has been reported from Piklihal. According to the excavator (Allchin1960: 112) this curious article formed part of a shuttle, and was not an arrow-point or spear-head. The first real discovery of bone tool-kit of Neolithic times was made in Burzahom in Kashmir. Neolithic Burzahom has been assign-to two periods. Bone tools are met with in both periods, but according to the excavator. Bone tools are more frequent in period-II than in Period- I (*IAR* 1960-61: 11-12). The bone- tools are highly polished and have sharp working ends. Amongst the types reported are short daggers, points both large and small, awls, antimony rods, polished, scrapers, chisels, needles with eyes, arrow-heads, and harpoons (*IAR* 1961-62: 17).

The remarkable discovery of the Neolithic bone artefacts at Chirand has provided ample material to the archaeologists for the study of the primitive of the bone tool making and assesses the maturity of the vision of the people who manufactured them. It is fascinating to know as to haw the people managed the various needs of their daily life with the boon tools. (Narain 1972: 1-2).The artefacts were exhumed from the habitation area which in thickness varied from 1.50 metres to 2.50 metres. Varieties of animal bones were discovered from this horizon. A glance at them immediately reveals that the bone out of which the artefacts were manufactured still preserved whereas the discarded bones either disintegrated or were in the process of the decay. How could these artefacts survive to this day is a matter of added importance which requires close examination. It is, therefore, essential to have understanding in to the properties and the structure of the bone at first hand. Total 150 tools of bone and antler have been reported. On functional basis they were grouped into thirty varieties **(Fig. 3).** The raw material used in their manufacture was either the antler bone or the long bones of the cattle or deer.The tools were made on antlers, semi mineralised bones of humped cattle, sheep, goat and tusk of wild boar. Bone-Celt has been reported from this site Tools generally have been prepared on semi mineralised bones but those prepared on ordinary bones have been charred in order to provide more compactness and strength. While making bone tools an attempt has been made to take advantage of the natural shape, size and sharpness of the fragments. In some cases, the tortoise shell and ivory were also made use of (Narain 1972: 5).

Figure 3: Some signature collections of Bone and Antler tools, Chirand (Courtesy: Bihar Museum, Patna)

The working of bone originally started with spilitting it in order to extract the edible marrow. The method of breaking long bones were not as simlpe as one might first suppose, if we may judge by the material from Crimean caves (Kiik-Koba, Kosh-Koba, Chokurcha and others). During Palaeolithic period man sometimes extracted the marrow from bone wall, that is by a kind of trepanation. This method of cutting a hole was evidently a habit of upper palaeolithic times (Semenov 1964: 145).The oldest evidence for the use of bone is provided by the materials from the cave of Chou-Kou-Tien. The early Pleistocene inhabitants of China, *Pithecanthropus pekinensis*, possessed both stone tools and fire, and naturally he was unlikely to neglect a material like bone, which could be put to good use without much effort. Usuallu he employed deer or gazelle antlers, but inasmuch as fresh deer antler is difficult to break, he often used not only stone tools but also fire for working it, as Breuil has shown (Semenov 1964: 145).

Initiated by Semenov (1964), microwear analysis has gained popularity in the west and the rest of the world. Among others, Shiner and Porter (1973), Tringham*et al.* (1974) have done fundamentally important studies. Of course the most influential work of recent times is Brian Hayden's *Lithic Use-wear Analysis.* This demonstrates suitably the range of deductions form observations at a micro level and the variety of approaches in microwear studies. Fundamentally this work demonstrates that the wear marks are not complete as a dataset in themselves. Rather, the type of wear patterns and their frequency must also be observed. In other words, when the task of observing wear patterns ends, the task of making meaning out of them begins. In the West, where such studies first commenced the work of Sergei Semenove (1964) was considered pioneering. The English edition translated by Mark W. Thompson of the *Prehistoric Technology,* provided the Anglo-American world the first glimpse of this technique although it has been argued that examples of this kind of work exist from an earlier period in the West also. At the time of the publication of his seminal work *Prehistoric Technology,* Semenov had already worked no less than two decades using this approach. It is suggested that his preliminary work had spurred a number of workers, in US and the UK to replicate such analyses. However, these had significant differences both in theoretical aspects and the equipment used. The work of Tringham*et al.* (1974), Keeley (1971, 1973, 1974) Odell (1979, 1980), Vaugham (1979) and Mark Newcomer (1979) are some examples of the post – Semenov methodological refinements. However, this method may further be defined as involving experimental work leading to inferences about archaeological artifacts. Experimental research and observation of microwear traces and edge characteristics has been done extensively by Odell (1975), Tringham*et at.* (1974), Semenov (1964 and Keeley 1980).

Probably bone was selected as tool manufacturing material, because it was easy to work and hard in character. First the bone must have been used in their original and natural forms, but afterwards they were given the desired shapes, according to the needs, by the Neolithic man. As for example, sharped edged heavy tools were required for cutting the fire wood, pointed spear-heads for fishing and shafts and handles for manufacturing the micro-lithic tools.

Bone is formed of many chemical compounds like calcium carbonate and many other salts (Cornwall 1960: 204). Externally it appears very tough to a naked eye but actually has fibrous character. The fibres in the cortex portion are very compact but in the articular ends they have spongy look. The organic material in the form of fat and marrow remains present in the hollow cavities. They provide strength to the bone when the animal is alive but help quick disintegration when it is exposed to the weathering agents. Experiment has shown that fresh bone, whose cavity is filled with marrow and blood when subjected to pressure, breaks in irregular way (Mourice 1961: 28). Hence, it is difficult to fabricate artefacts to the fresh bones.

The Neolithic craftsmen must have carefully observed these facts and thought it essential to devise artificial means to season the bones before they were converted into tools and weapons. The study of the modern methods of bine working may be quite helpful to understand the primitive techniques bone-tool making. As to the techniques employed for the manufacture of these tools and artefacts, it may be mentioned that proximal and distal ends of the metacarpal and metatarsal bones were first separated by down-cutting and then they were split vertically and rough-outs of the artefacts were taken out. There are 23 specimen that range in length between 3.2 cm and 7.1 cm while the pointed pencil represents the drill like tools that show a length range between 7 cm and 16.5 cm (Pratap 2013: 264). This uniqueness is extremely highlighted by it bone-tools of the total 150 bone artefacts discovered from Chirand, 17are un-stratified. The breakup of the remaining 133 tools classified according to their supposed functional uses is as follows **(Fig. 4)** (Sinha 1979: 72):

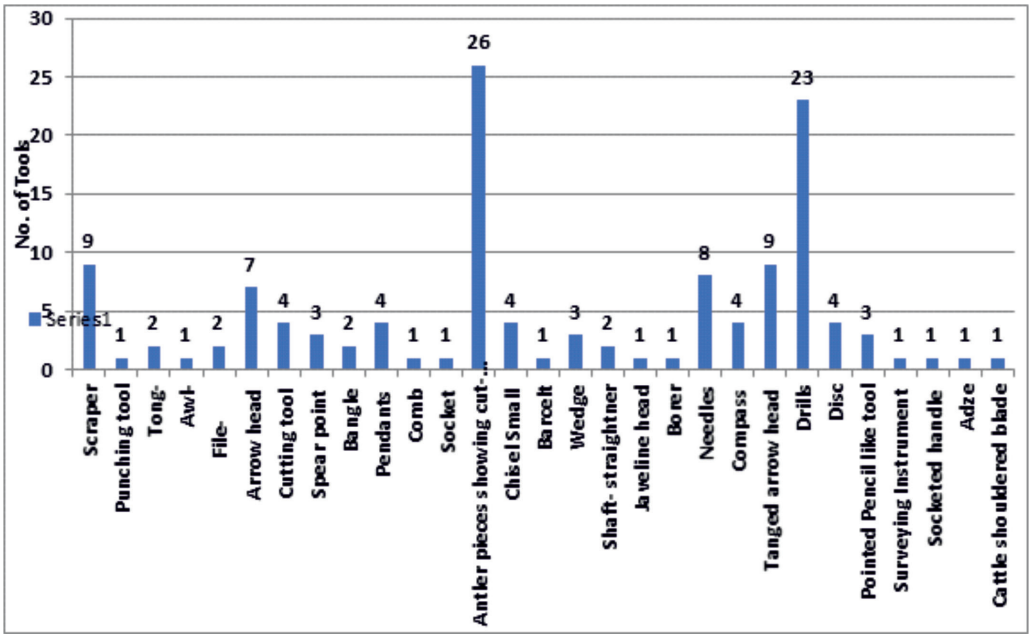

Figure 4: Numbers of Classified Bone and Antler Tools, Chirand

The technique used in the preparation of bone tools is almost the same as employed in the preparation of stone tools. The tools have been prepared by using such techniques as softening, percussion, flaking, splitting, cutting, notching, grinding and tempering. Flaking, splitting and scrapping were done by the stone adzes found at the site. Bone tools recovered during excavation fall into the following categories (Narain 1972: 4):

(i) Hunting tools (ii) Domestic tools (iii) Digging tools

(i) Hunting tools consisted of points, spear head, barbed spear head, and long points, 27 cms long and single-row harpoons.

(ii) Domestic tools are represented by needles, engravers, burnisher, adze, blades, scrapers, side scrapers, borers, awl and denticulate blades which were used for harvesting.

(iii) Digging tools consisted of chisels and digging tools i.e. long tools with pointed edges.

Now, in this background, it would be interesting to study the techniques applied in the manufacture of each variety of tool discovered at Chirand. The various simplest methods of making bone and antler tools in Neo-Chalcolithic period as follows:

Softening Bone

Undoubtedly there is no necessity to soften the bone of a freshly killed animal when splitting, grooving, incising, retouch were used. For splitting and retouch indeed slightly dried out bone would have been better. This is particularly the case with deer antler, which is extremely resilient in a fresh state. Semenov had done a great work in this respect. He had done an excellent experiment by using both dry and wet bone and antler. In first step he had used a prepared knife of metal to scratch the dried bone surface which was dried out for several month altogether and felt very hard to remove the layers. Then in 2nd step he applied the wet method. Firstly, the long bone that has been allowed to dry out for several months, and then on the same bone after it has been soaked in water for several weeks and absorbed moisture that increased the weight by 7 per cent, demonstrating a relatively high degree of hydroscopicity. In this way working (whittling and burin work) on bone was made appreciably easier; parings three to four times thicker could be taken off (Semenov 1964: 159).

To-day bone is boiled in a solution of soda and water to a boiling point to extract the organic materials (fat and marrow). After this it becomes porous, light in weight and partially immune from decay **(Fig. 5).** It is dipped for a week or two in a solution of silicate of soda 1 part and water 3 parts and again in chloride of calcium solution 2 parts and water 3 parts for a week or two. These solutions fill the porous surface and provide strength to the bone (Hopkin, 1919: 573). The methods described above do not seem to be much complicated. The soda and the calcium compounds may have been within the reach of the Neolithic craftsman at Chirand. Another method was also being experienced by the scholars. That is of steaming method. If damp bone has thoroughly heated it would be possible to give it a curvature. in order to make dry bone elastic it must be heated in damp conditions to prevent it cracking. There is ground for supposing that Palaeolithic man did not always resort to softening: he adjusted himself to the condition of the material and did what was possible with the normal methods of work. He worked quickly, employing complicated and laborious techniques only oif necessity, when normal methods did not give the required results.

'After thorough soaking for five days a lump of bone was wrapped up in a piece of fresh skin, itself also soaked until it was swollen. The skin with fur inwards was twisted round the bone three times, and the whole packet was put into the camp fire and kept there until the skin had completely charred, which took one hour forty-five minutes. The soft skin wrapping was completely charred falling to pieces at a touch, and the temperature of the bone was so great that for some time it was impossible to hold it in the hand. It could be freely whittled with a knife with stone blade giving long spiral- like parings. An ivory strip could easily be bent after steaming in this way' (Gerasimov 1941: 70-71). The careful dismembering of the different parts of the animal bone and their dumping would have been the first step. The marrow in the bones would automatically cause the formation of bacteria which would destroy the major portion of it. The extraction of the remaining marrow from the inner most cavities were possible either by boiling or by heating in the fire. Most of the artefact discovered did not show any sign of burning. It is obvious, therefore, that the marrow from the original bones of the artefacts was extracted by boiling. Soda and calcium compounds are the two main chemical used to-days to extract the marrow. Soda is prepared out of saltpetre. It has got great cleansing property because of its alkaline nature. At Chirand it is still available in plenty (Roy Choudhary 1960: 6). The discovery of some Neolithic pots with lime incrustation proves that they knew about lime and probably derived by burning the shells of the Mollusca and the snails. We can, therefore, confidently say that the soda and the calcium were available in their crude forms of the Neolithic craftsmen of Chirand. Weather they used these chemicals for extracting the marrow is difficult to say unless chemical analysis of

the artefacts confirms it. The porous surface of the boiled bone was filled with liquid wax to provide strength and also to protect from the absorption of moisture (Narain 1972: 3-4).

Figure 5: Process of Bone Softening

Once the desire piece was detached from the original bone, it was dressed with stone blade to make a rough-out of a tool which the craftsman intended to make. It was rubbed against sand-stone pieces to make the surface smooth. Such sand-stone pieces were discovered in appreciable number from the site. Finally, the tool was filed down to give regularity to the form and to provide sharp working end. Eyes or the holes in the tools were made with the bone drills of various sizes.

Chipping

As stone tools the 1st stage the selected bones taken to one place for chipping. The required size bone pieces flaked from one side to achieve a good shape. But the chipping technique used for the bones is very controlled due to the chance of sudden breakage of bones. To avoid it and to maintain the slow and controlled process needs (Narain 1972: 4). The hammer used for chipping out the surface bones are the harder and sharper variety, otherwise the determined shape will not achieve. Slowly all the un-required part removed and rough shape came out.

Bone Breaking

The simplest means of modifying bone is by breaking the bone on an anvil with a large hammer stone **(Fig. 6).** This technique was commonly employed to extract nutritious marrow from the bone cavity. Long bones of large animals can be cracked and broken into sharp splinters suitable for immediate use as picks or scrapers or for further modification into awls and other tools. This technique of breaking bones is relatively haphazard, but when coupled with other methods such as grooving or sawing, it can be used to shape more sophisticated tools. A technique of striking was very often used in working ling bones. The hard material of the diaphysis would be difficult to whittle and not always easy to cut with a burin. A diaphysis that had been split longitudinally could easily be worked by blows directed from the outside inwards, putting the splinter on a hard rest (Semenov 1964: 147).

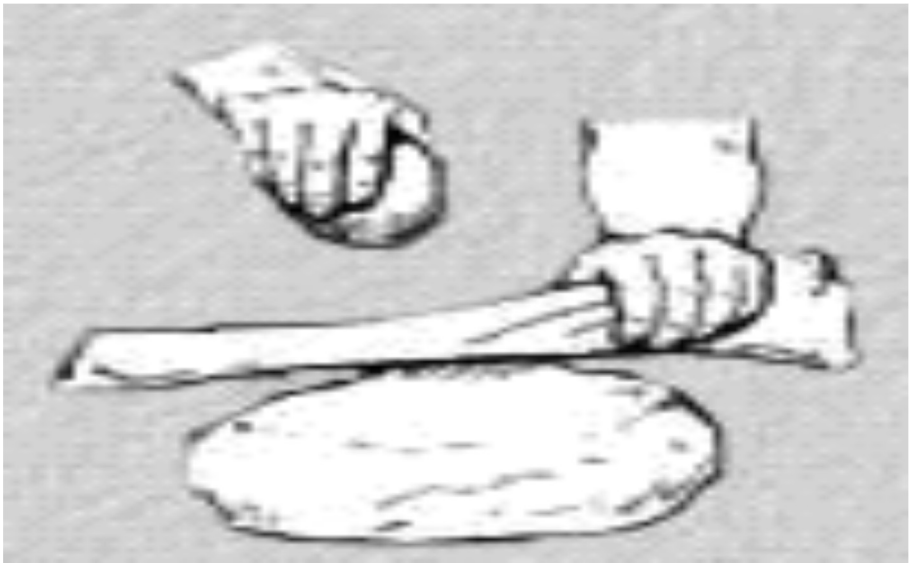

Figure 6: Breaking Bone Using the Anvil Method

Splitting

The working of bone originally started it in order to extract the edible marrow. The method of breaking long bone was not as simple as one might first suppose. The long bones were not simply splintered with a stone so that the piece of marrow could be picked out of the pieces. The bamboo splitting wedge was made of the red deer antler **(Fig. 7).** The brow-tine at a little distance above the burr was rubbed obliquely and the bez-tine was cut half way with the gut. The half cut portion was broken longitudinally with the bone –chisel in such a way that a wooden handle could be fitted to it. Due to constant handling, the burr portion got polished and the working end bore irregular scratch. The illustration at explains its probable use (Narain 1972: 7).

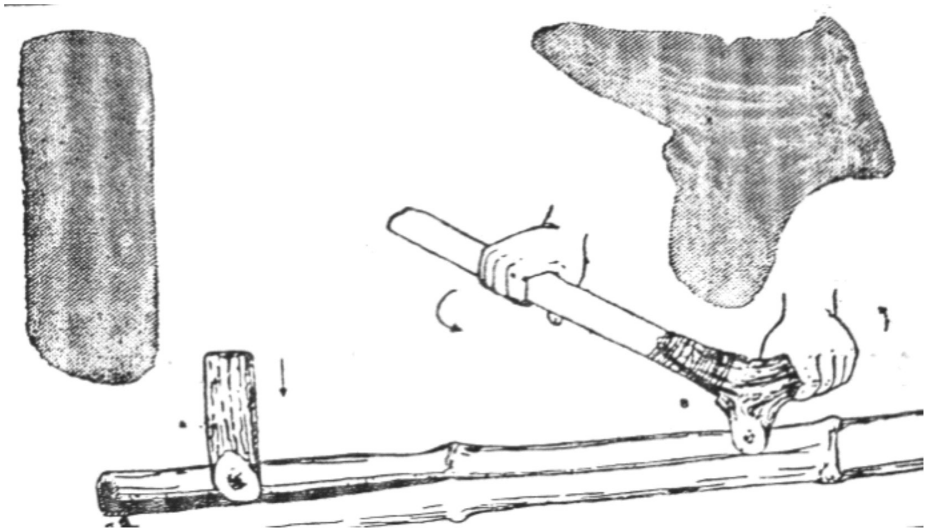

Figure 7: Splitting

Simple method has been used having selected the spot on the antler where he wanted to sever it, it was first burnt and charred over a fire, and then the charred place was scraped with a piece of stone. The notch produced was like a V shape, penetrating through the external compact layer into the spongy matter below. After this the bone would be broken without difficulty.

Grooving

For some delicate bone tools, it is first necessary to score the parent bone. Grooves outlining the intended tool's form are cut through the hard outer bone to the spongy cancellers tissue using stone tools such as sharp pointed gravers and chisel-ended burins **(Fig. 8).** The piece can then be broken free with relative ease and made into an awl or needle. Grooving bone with a modified flake tool can be slow. Soaking the bone in water for a few days can speed up the process by temporarily softening the bone, making cutting and scraping easier. Once the bone is dry, it will return to its hard, resilient state (Semenov 1964: 151-152).

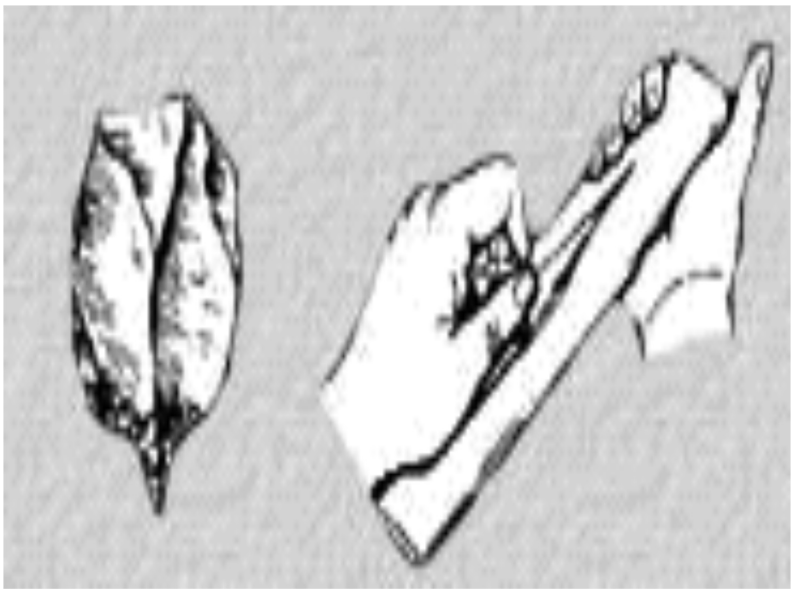

Figure 8: Grooving Process

Striking

In Neolithic period there was a crucial advanced in the technique of making tool. The flaking of blades off cylindrical cores created a range of flint tools, including instrument suitable for cutting, which was the most important achievement of the new technology. Among implements that appeared from upper Palaeolithic times the burin has a special place with fundamental significance for bone-working. Burin work on bone constitutes the most refined method, but in addition there were many others. Amongst a variety of technical methods of working bone an important part was still played by percussion and splitting, which had arisen much earlier. On flat bones of animals (shoulder, pelvic and skull), on flakes of ivory and especially on long bones one often sees traces of blows along the edge in the form of rough angular facets, which gave the necessary shape to the bone. Such a rough percussion technique is to some extent merely a copy of the old methods of working stone. A technique of striking was very often used in working long bones. The hard material of the diaphysis would be difficult to whittle and not always easy to cut with a burin. A diaphysis that had been split longitudinally could easily be worked by blows directed from the outside inwards, putting the splinter on a hard rest(Semenov 1964: 147-148).

Sawing

In the daily line of Neolithic people long bones of such small animal as hare and fox were widely used. Hard and very tough in structure, they were employed for a variety of small articles: awls, needles,

perforators, beads and so on. Yet small bones are very difficult to divide transversely with a burin, which had perforce to be done by sawing **(Fig. 9).** In certain cases, the bone has been swan half or a third of the way through and then broken, giving an uneven toothy end to the broken edge. In order to get a smooth end the bone could be sawn through on all sides right the way round. After breaking there was only a slight waviness on the inner edge of the bone wall; the end of the break otherwise was reasonably smooth. In the micro-photograph of the stump of this bone, five sawn grooves made one after another and the 'fringe' of unsewn broken bone, is clearly visible(Semenov 1964: 151-153).

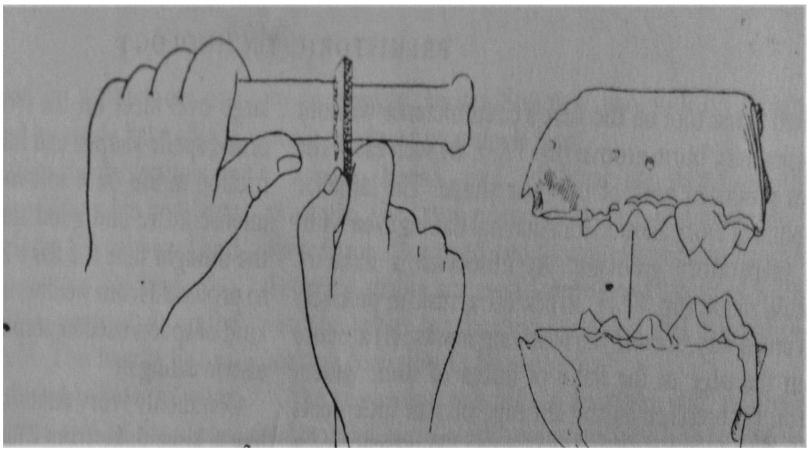

Figure 9: Bone Sawing

Flaking

The longitudinal division of mammoth tusk was achieved by man in several ways. The first and most simple were to strike off flakes by blows with pointed stone tools on the tusk's circumference without a preliminary burin groove. In such cases the flakes produced were of irregular shape(Semenov 1964: 154). The lamellar structure of ivory allowed longitudinal flaking even without preparatory grooving. Commonly ivory flakes underwent a finishing process like a large flake out of which a scoop was made. Its handles were formed by a notch cut out with a knife and by a side flake off the narrow ridge on the left. In addition, the projections on the inner layer of ivory on the working edge had been planned off **(Fig. 10).**

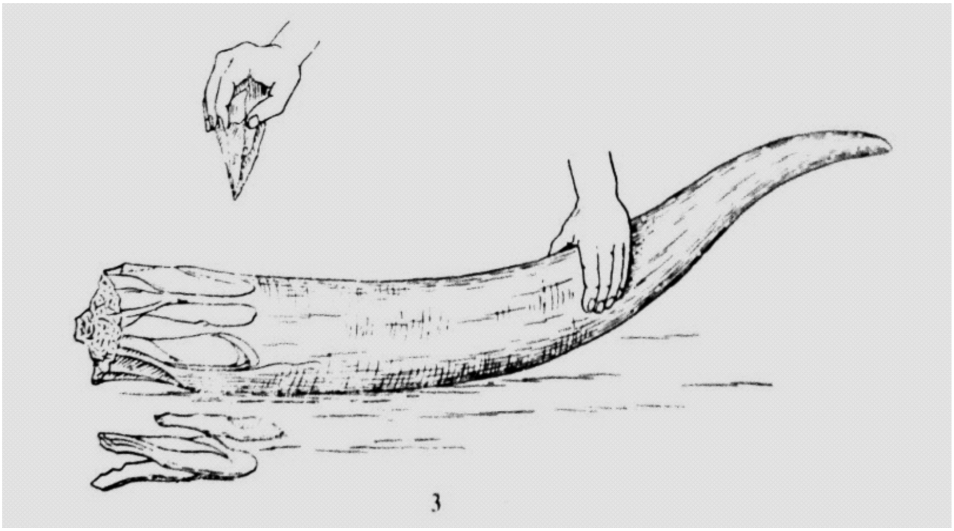

Figure 10: Flaking

Cutting

To make out certain types of bone tools this method was used. Basically, long bones of different animals collected for making the bone implements, and according to the requirements they cut down into pieces. For scraping and cutting the bone the blades and the composite tools as sickle or zigzag sided blades were used. Bone becomes soft when it is boiled. It is cut, holds or bent in any direction only when it is warm. A careful examination has revealed that for a vertical cut a straight line was drawn on the cortex s of the canon-bone with a stone blade **(Fig. 11).** A deep groove was made along the straight line with the repeated pressure of the blade. The bone was them split into two part. For round cutting, carefully positioned groove was made round the antler bone. It was ditched by the back and forth movement of the gutor the hair-thread in the manner. The round cutting of the canon-bone was done by stone blades only (Narain 1972: 4). This process must have been very tiresome because of the compactness of the fibres in the cortex portion especially in the antler.

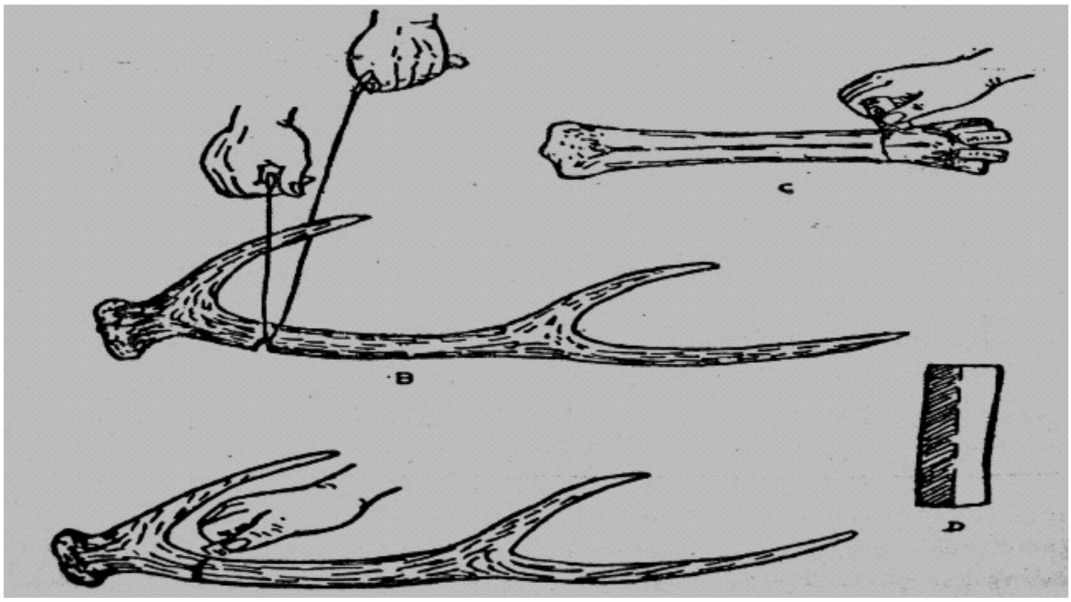

Figure 11: Cutting

A more difficult, but technically more accomplished, method of dividing bone transversely and longitudinally from upper Palaeolithic times was by cutting with a burin. The invention of the burin in this period can be regarded as a very great step forward in the field of technology. In order to appreciate this fact fully attention must be turned to the full flowering of manufacture of bone tools in Neolithic times, including artistic burin work on bone. There can scarcely be any doubt that the burin was created by the need for more skilful division of bone (Semenov 1964: 155). From Upper-Palaeolithic time man invented an instrument and started a method of cutting which today is the basis of machine-engineering, as well as the whole of industry itself. In order to justify a statement that at first glance seems very rash it is sufficient to observe that almost all the basic and essential details of machinery and mechanism used for lathes, and in cutting and rolling steel mills rely on burins.

Whittling

In the finding of the tools from Chirand this technique were being used. Traces of whittled bone indicate that this method of work was well understood from upper Palaeolithic times. Two methods of whittling can be distinguished. One can be described as a sort of scraping with the blade held almost

at right angles to the bone surface **(Fig. 12).** The traces on the bone consist of parallel lines slightly wavy and at closely spaced intervals characteristic of this type of work. From upper Palaeolithic times whittling was not confined to the method just described that is a sort of scraping. Bone material extracted by splitting was used for rough outs, on which there are very often all kinds of bumps and torn edges which had to be removed by the cutting type of whittling. An example of this king of work is the working of wood with a knife and plane in contemporary peasant industries. On Palaeolithic bone articles similar surface alteration are visible characterized by facets, notches, cut and hollows. It would have been impossible to carry out such work on bone without a whittling knife. Undoubtedly grooving and chopping with flint axes would also be used, but even then the final touching up required whittling to smooth off the chopped surface (Semenov 1964: 159).

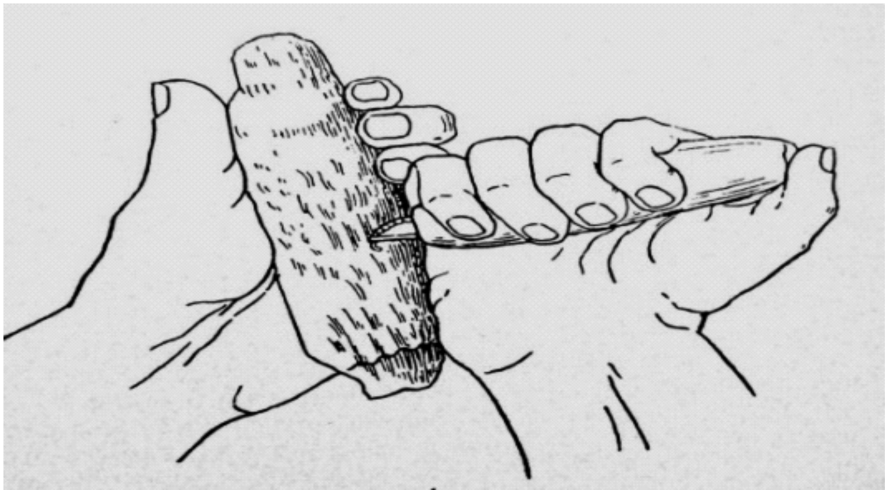

Figure 12: Whittling

Polishing

The artefacts automatically got polished due to the prolonged use and their long exposure to the atmosphere turned them yellow. However, certain objects like the pendent and the bangle were deliberately polished **(Fig. 13).** Before rendering polish, the object in all probability, was rubbed with hide full of hairs to produce gloss over the surface. It was then coated with thin flam of liquid wax moisture (Narain 1972: 5).

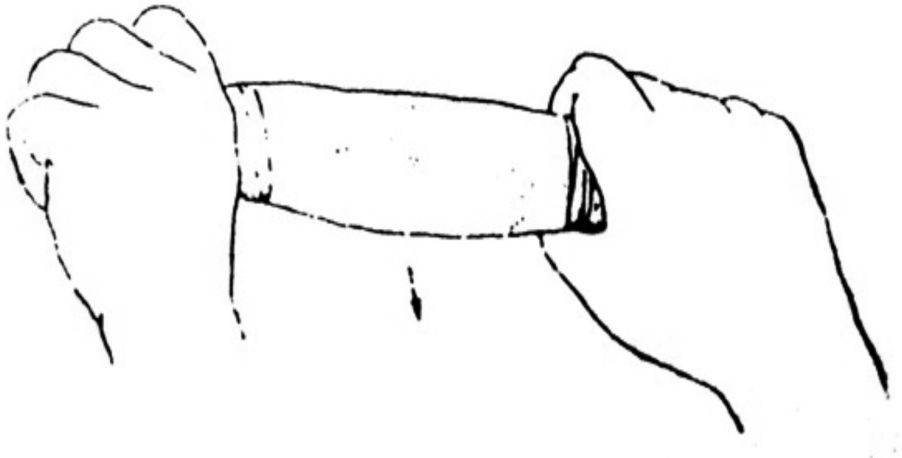

Figure 13: Polishing

The tools were made durable by subjecting them to fire but before placing in the fire they were covered with clay. In some cases, only the working point was fired to provide strength to it. Once the bone was carbonised, it became sufficiently strong and resistant to chemical change. If the artefacts would have been subjected to directed flames of the fire, there was danger that the fibres would burn completely and turn to ashes. One such clay embalmed artefact was discovered from the excavation which substantiates the above observation. The ecological setting of Chirand was such that it promised to offer regular supply of food and water. The monsoon type of climate in the area helped the growth of the luxuriant jungle in which the animals of open country forms must be roaming about. The area was always susceptible to flood as it was situated near the Ganga. The extra water in the Ganga must have caused the formation of many water- pools where the presence of aquatic species could not be rule out. Aside incipient agriculture, the fauna and the aquatic species formed the perennial source of subsistence of the people living there. To exploit the natural resources, they needed tools and weapons which could be effective in killing the games and in meeting many other needs of daily life. Stone was scarce in the area and in in the absence of metallurgical knowledge the people were left with no other alternative than to look for their own environment. Their matured observation of natural objects helped them to relies that the animal bones could be transformed into tools and weapons but to arrive at this conclusion they must have taken sufficiently long time (Narain 1972).

The thorough understanding into the structures and the properties of animal bone helped them to think that the organic materials in the bones caused quick disintegration and so they developed artificial means to arrest their easy decay. They selected only those parts of the animal bones which would be suitable for manufacturing a particular type of tool. In the way we can say that they had understood some principles of chemistry and the animal anatomy.In the end it is worthwhile to say that the Neolithic craftsman of Chirand must have fairly long tradition in bone working behind them, otherwise it was not possible to manufacture such a wide range of bone artefact in a masterly way. On the basis of reported artefacts from Chirand excavation, it can be concluded that Neolithic culture at Chirand was very well developed. The findings of antler tools, especially, as well as different types of other bone tool suggested that the technology at Chirand was very well organised. As the local ecology of Chirand during Neolithic is likely to have been forested the Neolithic economy at this site favoured not only cultivation but animal proteins and products acquired both by hunting and domestication is believed to have been engaged in during the Neolithic.

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References

Allchin, F.R. 1960. *Piklihal Excavations,* Andhra Pradesh Government Archaeological Series, No. 1. xvii, Hyderabad: Government of Andhra Pradesh.

Cornwall, I. W. 1960. *Bone for the Archaeologist.* phoenix House Ltd., London.

Gerasimov. M.M. 1941. *Materials and Researches on the Archaeology of the U.S.S.R.* 2. P.73.

Hazarika, M. 2013. Cord-impressed Pottery in Neolithic - Chalcolithic Context of Eastern India.In *Neolithic-Chalcolithic Culture of Eastern India*, ed. K.N. Dixit, Special Report No. 5, New Delhi: Indian Archaeological Society.

Hopkins, Albert. A. 1919. *The Scientific American Cyclopaedia of Formulas*. New York, Munn & Co.

IAR: Indian Archaeology- A Review (Volumes cited in the text.).

Keeley, L.H. 1973. The Methodology of Microwear Analysis: A comment on Nance. *American Antiquity* 38.

Keeley, L.H. 1974. Technique and Methodology in Microwear Studies: A Critical Review. *World Archaeology* 5(3): 323-336.

Maurice, Daumas. 1961. *A History of Technology and Invention.* Bombay: The Tulsi Shah Enterprises.

Narain, L.A. 1970 - 71. the Neolithic Settlement at Chirand. *Journal of the Bihar Research Society* 56: 1-35.

Narain. L.A. 1972. A Study in The Techniques of The Neolithic Bone Tool Making atChirand and Their Probable uses. *Journal of The Bihar Research Society* Vol. 58, Parts 1 - 4: 1-24

Newcomer, M.H. and L.H. Keeley. 1979. Testing a Method of Microwear Analysis with Experimental Flint Tools. In *Lithic Use - Wear Analysis,* ed. B. Hayden, 195-205. London: Academic Press.

Odell, G.H. 1979. A New Improved System for the Retrieval of Functional Information from Microscopic Observations of Chipped Stone Tools. In *Lithic Use-Wear Analysis,* ed. B. Hayden, 329-44. London: Academic Press.

Odell, G.H. and F. Odell-Vereecken. 1980. Verifying the Reliability of Lithic Use-Wear assessments by Blind Test: The Low-Power Approach. *Journal of Field Archaeology* 7: 87 - 120.

Pratap, A. 2013. A Microware Study of some Tools from Chirand Neolithic: A Preliminary Analysis. In *Neolithic-Chalcolithic Culture of Eastern India*, ed. K.N. Dixit, Special Report No. 5, New Delhi: Indian Archaeological Society.

Roy Chaudhary. P.C. 1960. *Bihar District Gazetteer (Saran*) Published by the Government of Bihar.

Semenov, S.A. 1964. 145 *Prehistoric Technology* (Translated by M.W. Thompson). London: Cory, Adams and Mackay.

Shiner, J. and J. Porter. 1973. Scanning Electron Microscopy of Prehistoric Stone Tools. *Texas Journal of Science* 25.

Sinha, B.P. 1979. *Archaeology and Art of India*, Delhi: Sundeep Prakashan.

Sinha, H.P. 1994. *Archaeological and Cultural History of North Bihar with Special Reference to Neolithic Chirand.* Delhi. Ramanand Vidya Bhawan.

Thompson, M.W. 1964. Translator's Preface in Semenov 1964, q.v., ix-xii.

Tringham, R. *et al.* 1974. Experimentation in the Formation of Edge Damage: A New Approach to Lithic Analysis. *Journal of Field Archaeology* 1 : 171-96.

Vaughan, P. 1979. Microwear Analysis of Experimental Flint and Obsidian Tools. 3rd *International Symposium on Flint, Staringia 6*: 90 - 91.

Verma, B.S. 1970-71. Excavations at Chirand: New Light on the Indian Neolithic culture - complex. *Puratattva*4: 19-23.

Verma, B.S. 2007. Chirand Excavations Report. Directorate of Archaeology, Bihar.