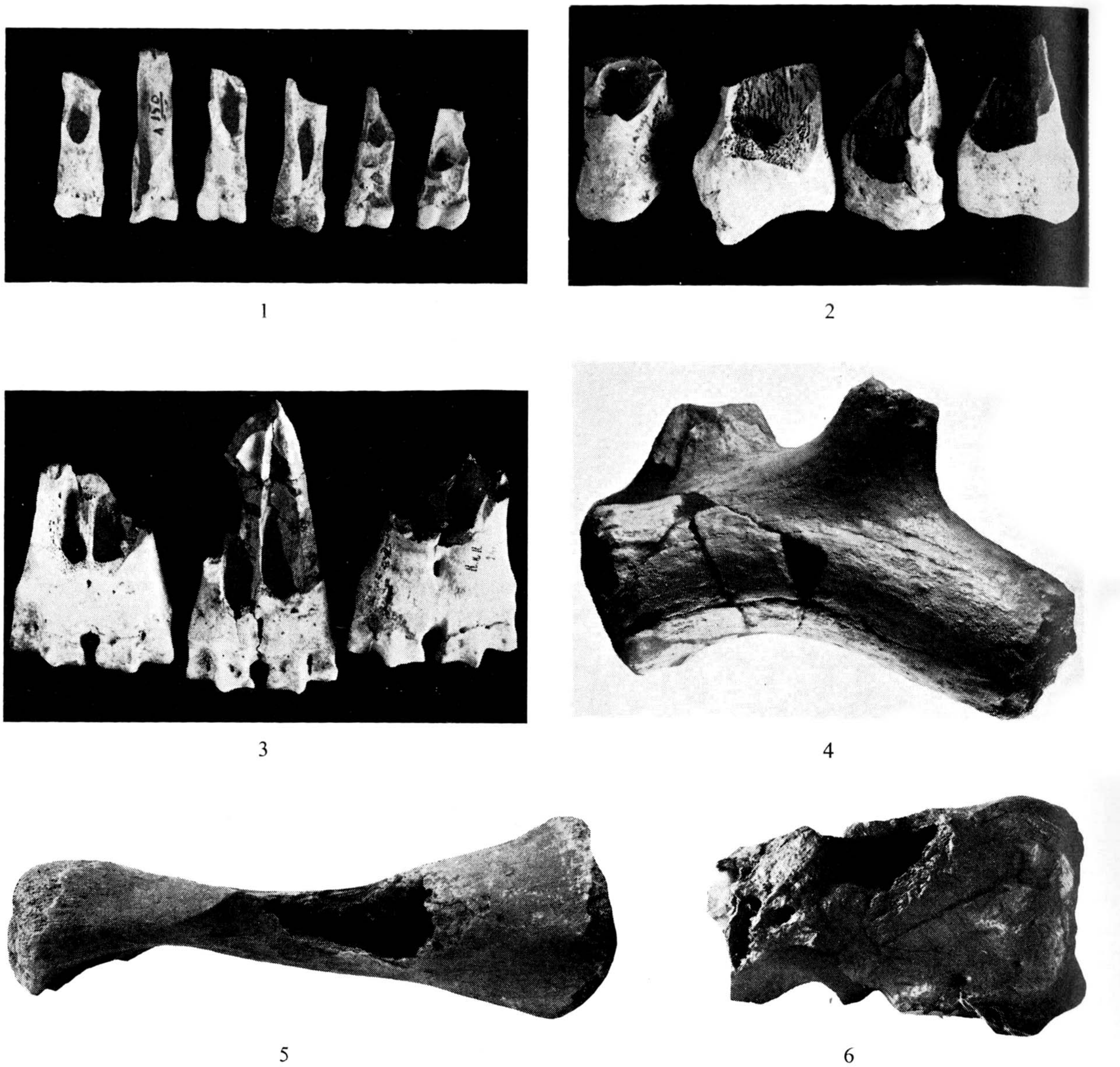
Section three | Bone



70 *Cracking and splitting long bones and chopping antler in palaeolithic times: 1–3 long bones split by Neandertal man in Crimean caves; 4 base of antler chopped with stone tool from Starosele, Crimea; 5 and 6 mammoth long bone (5) and skull of giant deer (6) trepanned by palaeolithic man.*

1. Basic methods of working bone in palaeolithic times

a. The simplest methods of working bone in lower and middle palaeolithic times

THE working of bone originally started with splitting it in order to extract the edible marrow. The methods of breaking long bones were not as simple as one might first suppose, if we may judge by the material from Crimean caves (Kiik-Koba, Kosh-Koba, Chokurcha and others). The long bones were not simply splintered with a stone so that the pieces of marrow could be picked out of the pieces. The epiphyses were skilfully struck off, so that the whole of the marrow could be obtained (fig. 70.1–3). Palaeolithic man sometimes extracted the marrow from bones of large animals by cutting a hole through the bone wall, that is by a kind of trepanation (fig. 70.5, 6). This method of cutting a hole was evidently a habit of upper palaeolithic times.

The oldest evidence for the use of bone is provided by the material from the cave of Chou-Kou-Tien, if we may judge by the observations of certain archaeologists.

The early Pleistocene inhabitant 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. Usually 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.

He used a very simple method. 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 Roman figure V, penetrating through the external compact layer into the spongy matter below. After this the bone would be broken without difficulty.

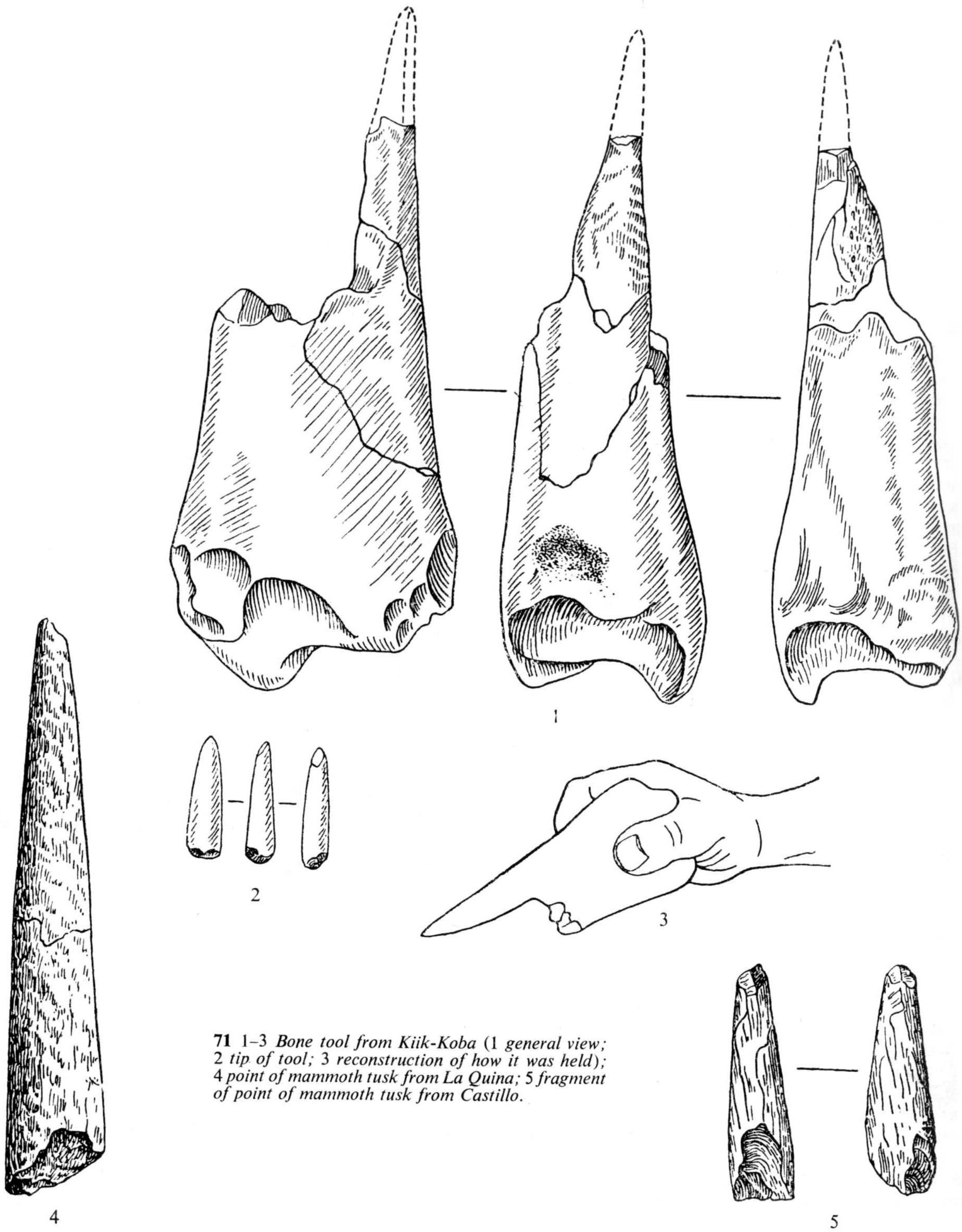
Attempts by Pekin man to notch bone with stone tools without fire are also recorded. They consisted of cuts on fragments of long bone probably caused in cutting off the meat and sinews from the bone.

He also employed one further method of working bone, percussion. In fact, skull, long and flat bones (shoulder and pelvic) had been worked by blows along the edge from a striker. For example, the frontal bone of a deer freed of antlers had very often been converted into a cup-shaped object, which, according to Breuil, could have been used for drinking water. Facets on the bone show that it had been worked from inside outwards, and the edges of some of the cups had been rubbed by use to a shine. When mandibles of deer, boar or hyena had been employed as tools a similar method had been used to strike off the upper projecting part. The working part of the jaw bone was at the front as revealed by traces on the edges of the tooth socket and the disappearance of some teeth, torn out during use.

In Mousterian times the use of fire in working bone continued. Burning and then scraping the burnt place with a stone tool is a very simple and quite rational method of working on such a hard and unyielding material as bone. For example, antler tools discovered in Java associated with remains of Solo man retained traces of the action of fire. These tools are shaped like picks and recall analogous objects used by Pekin man. However, the new Mousterian methods of working stone, which produced comparatively flat leaf-shaped flakes completed by retouch to form a sharp cutting edge, markedly advanced the techniques of bone-working. Such methods of work as whittling appear and also clear evidence of chopping bone. Amongst the bone material from Kiik-Koba there is one noteworthy object made on the left side of the mandible of a wild horse or donkey. On its thick rim traces of work with a thin-bladed tool are visible as short cuts running in a wavy line all along the edge. In the Mousterian deposits of the Crimean caves the basal parts of antlers have been found with traces of the tines having been chopped off (fig. 70.4).

In addition the inhabitants of Kiik-Koba used the metatarsal (*golen*) bone of horse to make a tool with a sharp end. First the proximal epiphysis was struck off and then the diaphysis was split longitudinally. When the marrow had been removed the bone was flaked to a narrow point, while the other end retaining its epiphysis served as a handle. The roughly shaped point could later be whittled and scraped with a flint tool (fig. 70.1–3).

The working of mammoth tusk by whittling has been



71 1–3 *Bone tool from Kiik-Koba* (1 *general view;* 2 *tip of tool;* 3 *reconstruction of how it was held);* 4 *point of mammoth tusk from La Quina;* 5 *fragment of point of mammoth tusk from Castillo.*

observed among Mousterian tools at La Quina and Castillo. H. Martin identified and published two points (fig. 71.4, 5), one of which was fairly large and could have been used as a head for a boar-spear.[1] The diameter at its base was almost 5 cm and it was 26 cm long. When complete it had been longer, but both the point and base were broken off. Slanting cuts show the whittling, so far as we can infer from the illustration.

Fragments of ivory tools found in Chokurcha Cave (Crimea) had also been worked by whittling. Part of a curved rod and a point from this cave had been ground down after preliminary whittling into shape.

Important evidence showing that Neandertalers whittled bone and wood has been found on a flint tool from Volgograd.[2] This is a flat flake bearing cortex on its dorsal side of the nodule from which it was struck. Seen dorsally the right side is blunted by retouch, while the left side is slightly notched with the facet on the ventral face. The wear traces in the form of polishing and striations detected with the microscope are on the ventral side. The length of the striations reveal that bone was worked not by crude scraping but by whittling, when the blade is at a slight angle to the worked surface. It is true that amongst all the material from Volgograd only one tool with such traces was found, while the other flakes had traces indicating that the blade was held almost at right-angles.

Thus already in early palaeolithic times very simple methods of working bone had come into use: transverse division of antler by using stone tools and fire, and percussion-dressing of long bones. Whittling of long and flat bones and ivory emerged later during middle palaeolithic times.

b. Methods of working bone by striking (flaking, notching, and chiselling) in upper palaeolithic times

At the beginning of the upper palaeolithic period there was a crucial advance in the technique of making stone tools. The flaking of blades off cylindrical cores created a range of flint tools, including instruments suitable for cutting, which was the most important achievement of the new technology. Among implements that appeared in 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 in upper palaeolithic times 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.

At Eliseevich cup-shaped objects were found with traces of use for trituration, probably of food. Some of them have retouched edges. Blows given on the concave side had produced irregular scars on the convex side, which give the external edge of the object its broken profile (fig. 85).

An excellent example of dressed bone is the mammoth shoulder blade from Kostenki I already cited. Here at the same time cutting had been used to remove unwanted parts of the bone and percussion with suitable blows to form the edge. The cutting had been done with a flint burin, which, as in other cases, marked out the line along which the flat part was to be broken off (fig. 89.1).

Thus the cited examples show us that palaeolithic man wasted his labour as little as possible and worked as quickly as circumstances would allow. The picture that is presented in archaeology of all manufacturing processes in the Stone Age being slow and laborious is quite baseless.

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 (fig. 72).

Traces of a percussion technique can be detected on mammoth tusk from its extraction from the alveolar socket up to its final shaping into a tool, that is varying from hard blows with a heavy stone to careful grooving with delicate hand movements and a suitable instrument.

The carcass of a mammoth would be brought from the point where it was killed to the hut already dismembered. A very valuable part was the ivory; sometimes the tusks were removed from the animal where it had been killed, pulled from their sockets after preliminary loosening by blows with large stones. The root of the tusk which was unsuitable for working because of its friability would be broken or chopped off.

Breaking off the root and severing the shaft of tusk into parts would have been attended by major difficulties; the large tusks of an adult mammoth, 10–15 cm or more in diameter, demanded expenditure of an immense amount of labour. To chop such a tusk would be possible only with a heavy stone wielded with both hands. Part of a large tusk examined from Kostenki I bore traces in the form of cracks and splintering from hard blows from

[1] H. Martin, *L'Anthropologie*, 42 (1932), pp. 679, 681.
[2] Materials from the site at Volgograd are housed in the Museum of Ethnology of the Academy of Sciences of the U.S.S.R. in Leningrad.

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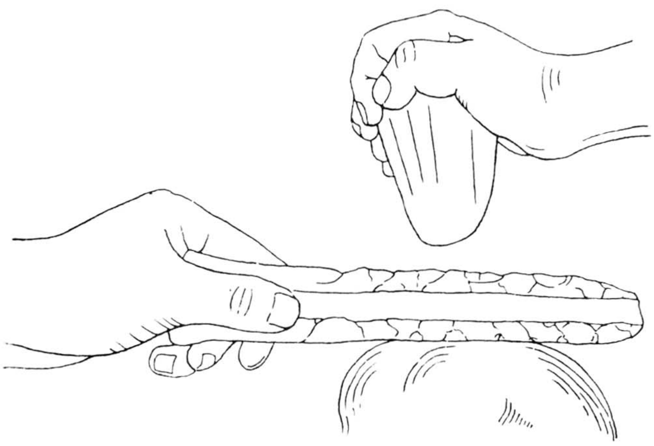

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72 *A long bone worked by percussion:* 1 *horse long bone with traces of working by percussion;* 2 *its method of being worked reconstructed.*

a heavy stone which had shattered the outer layer of ivory. The crushing was at the root of the tusk on its concave side, and the break had a torn profile. It is very probable that tusks were broken, or rather chopped up with the large flint axes, 'gigantoliths', found by Pidoplichka at Novgorod-Seversk (see p. 125 above).

At Kostenki I a method of chiselling or notching for cutting up ivory has been identified on the material including the tusk mentioned. At the other end this piece shows traces of being chopped through by notching (fig. 73). The tusk is 16–17 cm in diameter and the notch 4–5 cm deep. The notch had been made with a narrow chisel-like instrument leaving marks 4–6 mm wide. After notching, the tusk had been broken through with an exceptionally powerful blow, possibly the tusk itself being raised and struck against a rock.

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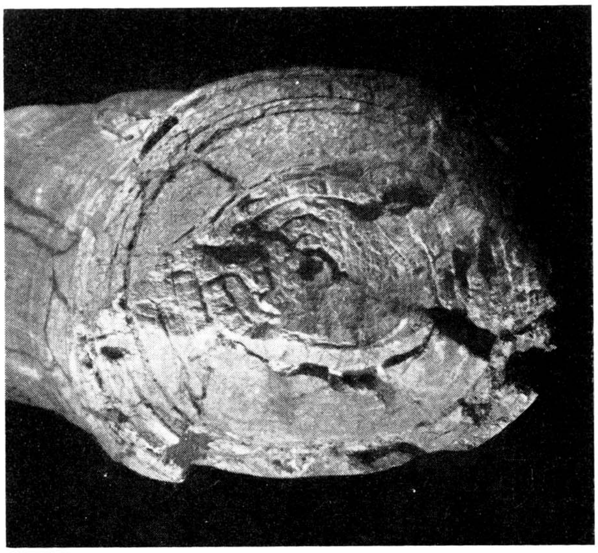

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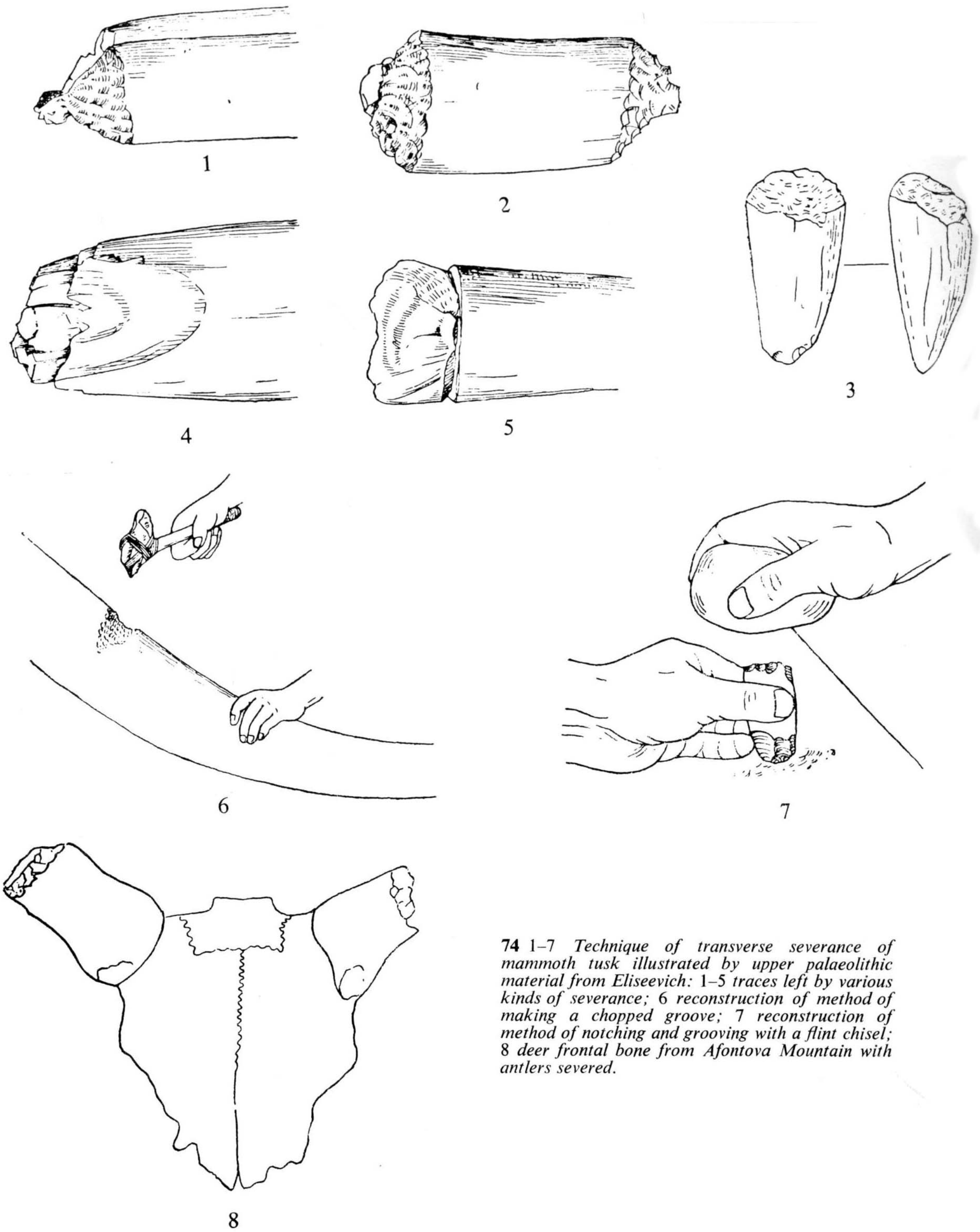
73 *An upper palaeolithic worked mammoth tusk from Kostenki I: 1 the root chopped off with stone tool; 2 sectional view of chopped end.*

With regard to the tool used to make the notch it is difficult to envisage its appearance. For operations of such a kind upper palaeolithic man had a range of possible implements, since any large pointed stone held either in the hand or mounted in a handle would be suitable (fig. 74.6). It is probable that flakes and blades were used as chisels and gouges. Such specialized tools (*pieces écaillées*) have been found on upper palaeolithic sites, consisting of flakes and even blades with wear facets on both faces. These facets as a rule have a wavy surface with sharp short flaking line and commonly a steep fracture. The character of the facets indicates that they arose not from pressure retouch but by direct blows into the flake in a vertical position on a hard base, and the facets are best regarded as signs of use, not as trimming. There are grounds for considering such flakes and blades as chisels or gouges for working bone and probably wood (fig. 75.7).

For transverse chopping axes were probably used as indicated by traces on the bone and the existence of axes themselves.

Transverse division of mammoth ivory by circular grooving is well exhibited on the bone material from Eliseevich discovered by K. M. Polikarpovich in 1936. At this site tusks of young mammoths were employed. An object that we examined was a cylinder 11 cm long and 4·5 cm in diameter, evidently a rough-out to be used for sculptural work (fig. 74.2). To judge by the traces the



74 1–7 *Technique of transverse severance of mammoth tusk illustrated by upper palaeolithic material from Eliseevich:* 1–5 *traces left by various kinds of severance;* 6 *reconstruction of method of making a chopped groove;* 7 *reconstruction of method of notching and grooving with a flint chisel;* 8 *deer frontal bone from Afontova Mountain with antlers severed.*

notch had been made by a small chopping tool with a narrow working-end. Blow by blow the palaeolithic craftsman had hollowed out around the tusk a broad groove deepening towards the centre. When only a narrow neck of ivory some 15 mm in diameter survived the tusk had been broken across by a sharp blow.

On another example (fig. 74.1) the craftsman's attempt to break the tusk can be seen after only taking the groove two-thirds of the way round. As a result he has not produced the desired result, for the tusk did not break quite along the right line.

Circular grooving of tusk would have given a positive result even if the groove was not taken very deep; a rough-out from the same site (fig. 74.5) shows that a groove of 10 mm on a tusk 45–50 mm in diameter was sufficient for the tusk to break along the right line. Other specimens from Eliseevich demonstrate a similar ratio, but on some even a groove of 10–11 mm deep in a tusk of 60–70 mm in diameter caused it to break exactly on the desired line.

Probably the results of severance by notching with a small groove depended on the ivory's condition. Fresh ivory splits better than dried-out ivory in which imperceptible cracks alter the direction of the break (fig. 74.4).

However, fresh ivory would have been extremely difficult to break across merely by striking without a notch chopped or cut round with a burin. A part of a tusk from Eliseevich illustrates this, one end of which has been broken by blows, the other grooved round by chopping with an axe. This ivory had been grooved and chopped while fresh, as is indicated by the conchoidal fracture lines, and also by the absence of longitudinal cracking found on dried-out ivory. The results of the two kinds of work were very different. The grooved part gave a clean stump, but the battered end shows a large conchoidal flake scar, as a result of which an appreciable part of the material had been wasted.

The technique of notching, which testifies to the patient and methodical character of palaeolithic man's work, was not confined to dividing tusks, but had a wide general application. It was used in the plastic working of ivory, when the form had to be changed, such as a part removed or a hollow or a notch made.

The part of the object from Eliseevich called a 'clapper' (*kolotushka*) which might be regarded as its handle is covered by traces of chiselling by blows from an implement with a sharp and narrow end. The depth of the holes is very slight, for to avoid flaking the material the blows were light but numerous, producing bunched masses of holes. At first glance the ivory's surface looks gnawed or rasped, and it is very rough to the touch (fig. 75.1).

It should be noticed that the handle-part of tools made of ivory found at Eliseevich are covered with cuts, even when the ivory in the remaining part of the tool is unworked. When considerable force was used the roughening of the handle prevented these tools from slipping in the hand. Amongst the ivory tools at this site was a dagger made from the tusk of a young mammoth, which was 26 cm long and 4·5 cm broad in its handle part. The natural point of the tusk had been sharpened by whittling. The object was broken in the middle and lacked its tip, but the clear traces it bore could leave no doubt about its use as a dagger. The handle part was covered on both faces by small cuts, where the palm and fingers gripped it hardest, to assure a firm hold. The necessity of this precaution to prevent the hand slipping by artificial roughening of the surface is quite obvious; the handle part tapers down to the point (fig. 75.4, 5). Another example of chipping the handle of a tool is part of the tusk of a young mammoth used without additional sharpening. The cuts have been made on the two corresponding opposite sides, and as in the former case the smaller area is intended for the thumb (fig. 75.3).

As an example of plastic alterations to ivory by means of grooving or notching there is a problematical object from Eliseevich, a large flake struck off a substantial tusk. The greater part of its surface is covered by cuts which, as in the preceding specimens, are tiny holes of irregular shape (fig. 75.2). At one end a notch has been cut which passes right through the ivory to give the flake a sort of bifurcation. The edge of the flake has been carefully worked by this notching technique. It is difficult to say what intention the palaeolithic craftsman had when he did the work, which either he left unfinished or spoilt by mishap and abandoned.

The most simple method of severing an antler transversely in upper palaeolithic times was by chopping through it with a sharp chopping tool. Without falling back on the old lower palaeolithic methods of burning over a fire, a deep groove could be made all the way round by hard blows with a flint axe on the desired line of division, deep enough to reach the spongy interior of the antler, which would then break through. Without a deep groove fresh deer antler, which is extremely resilient, would be impossible or at all events very difficult to break.

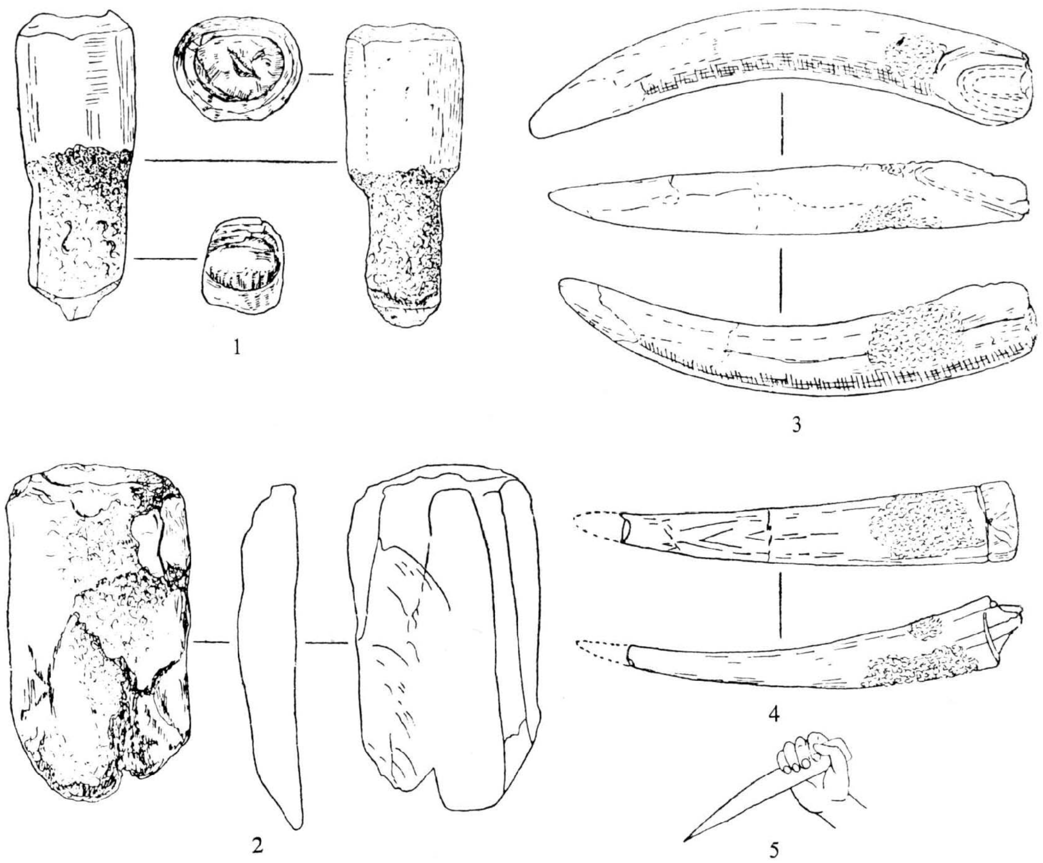
The upper part of a deer skull with chopped-off antlers from Afontova Mountain illustrates two such very simple methods of severing antler. The right beam has been grooved all the way round and then snapped off very evenly, almost as if sawn. The left beam was grooved only half the way round and then broken off unevenly, so that in part of the beam which was not grooved some of the compact layer of antler has been split off beyond the marked-out line of division (fig. 74.8).

c. Sawing bone

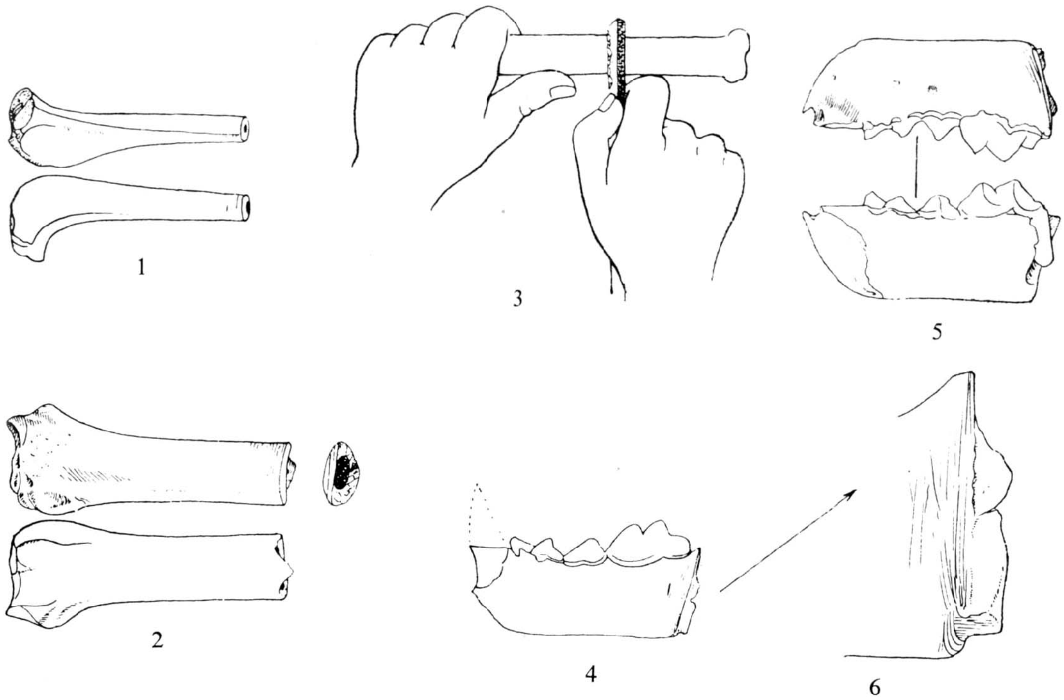
In the daily life of upper palaeolithic people long bones of such small animals as hare and polar fox were widely used. Hard and very tough in structure, they were employed for a variety of small articles: awls, needles, perforators, beads and so on. Yet small bones are very difficult to divide transversely with a burin, which had perforce to be done by sawing.

Examination of the material from Eliseevich confirms that transverse severing of bone objects was effected by sawing through with a retouched bladelet (fig. 76.1–3). The toothed flint edge was eminently suitable for this. In certain cases the bone has been sawn half or a third of the way through and then broken, giving an uneven toothy end to the broken edge (fig. 76.2). 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 unsawn broken bone, are clearly visible (fig. 76.7).

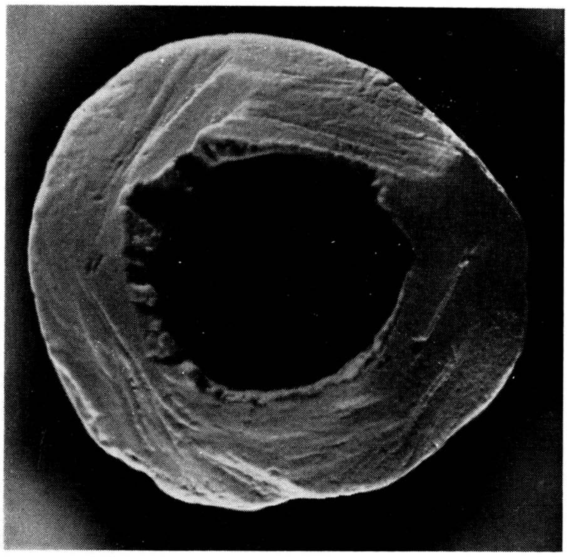
Palaeolithic man often used the mandibles of carnivorous animals with their sharp, sturdy canine teeth, as tools. A mandible for this purpose was broken into two halves with one canine in each half, the projecting parts being broken or chopped off, to give a beak-shaped tool. Implements made out of the mandibles of carnivores (bear, lion, tiger) were of considerable weight and size, and were commonly used for cracking long bones to extract marrow, which was practised up until the last century. Such a fact was noticed on the material from



75 *Ivory from Eliseevich illustrating upper palaeolithic work:* 1 *'bell clapper' made with burin chipping technique (axe blows are visible on the upper cylindrical part);* 2 *blade of ivory with traces of chipping;* 3 *tusk of young mammoth with two patches of chipping to give purchase for the hand;* 4 *dagger of ivory with two patches of chipping;* 5 *reconstruction of how it was grasped.*



76 *Upper palaeolithic bone sawing illustrated by material from Eliseevich:* 1 *and* 2 *sawn long bones of small animals;* 3 *the sawing reconstructed;* 4–6 *wolf mandibles* (*traces of sawing* (4) *enlarged* (6)*; traces of incising* (5))*;* 7 *micro-photograph of sawn end showing separate saw cuts.*



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the cave of Hohlfels near Wurtemberg by Fraas.[1] In addition there are numerous ethnographic parallels for the use of mandibles of small carnivores as tools. For example, we can quote the mandible of cynadon and other fresh-water animals used by the tribes of Bororo in central Brazil.[2]

At Eliseevich several wolf mandibles were found worked by cutting and sawing (fig. 76.4–6). The projecting parts had been cut away by two methods: on one examination of the cut showed the use of a burin, on the other signs of sawing with a retouched blade were visible. The purpose of these wolf mandibles treated in this way is uncertain.

To judge by the material from Avdeevo and other sites the ribs of large animals were divided by sawing with a flint blade.[3]

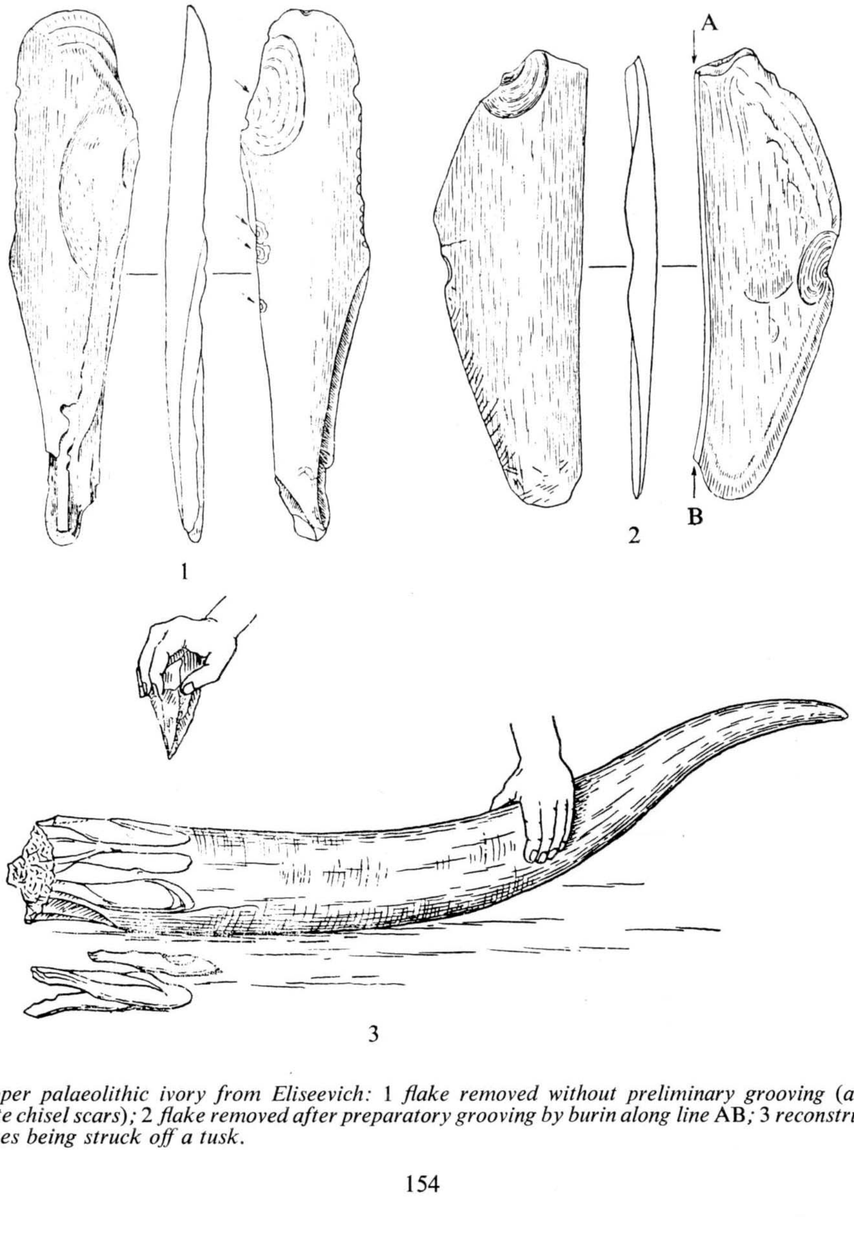
d. Flaking mammoth tusk

The longitudinal division of mammoth tusk was achieved by palaeolithic man in several ways. The first and most simple was to strike off flakes by blows with a

[1] O. Fraas, *Archiv für Anthropologie*, 5, p. 173.
[2] K. Steinen, *Unter den Natürvolkern Zentral-Brasilien* (Berlin, 1897), pp. 200–1.
[3] M. D. Gvozdover, *Materials and Researches on the Archaeology of the U.S.S.R.*, 39 (1953), p. 196.

pointed stone tool on the tusk's circumference without a preliminary burin groove (fig. 77.3). In such cases the flakes produced were of irregular shape. The lamellar structure of ivory allowed longitudinal flaking even without preparatory grooving. At Eliseevich a flake of spatula shape (fig. 77.1), struck off a tusk in precisely this crude way, showed the following marks: (1) absence from the edge of the flake of traces of work with a burin; (2) presence on the left edge of four little dents from four blows with a stone chisel; (3) presence of a large oval facet on the front flat end of the flake. The broad spade-shaped end had been polished all over from friction in use on a soft material. Its dark surface with intense lustre and good state of preservation prompted the thought that the flake had been saturated in fat and so protected from weathering. It is likely that it was some kind of spoon used in preparing a porridge-like food and also in eating it.

Commonly ivory flakes underwent a finishing process like a large flake from Eliseevich out of which a scoop



77 *Upper palaeolithic ivory from Eliseevich: 1 flake removed without preliminary grooving (arrows indicate chisel scars); 2 flake removed after preparatory grooving by burin along line* AB*; 3 reconstruction of flakes being struck off a tusk.*

was made. Its handle was formed by a notch cut out with a flint knife (on the right) and by a side flake off the narrow edge (on the left). In addition the projections on the inner layer of ivory on the working edge had been planed off. The scoop was 25 cm long, 8·5 cm broad and more than 1 cm thick, with a convex working edge rubbed from use. The edges are thin, particularly on the left, and have been broken in use. The handle has an unrubbed rough end where it had been held in the palm, contrasting obviously with the front end of the scoop, the thumb being accommodated in the notch. The scoop could have been used for digging and throwing out soil during earth-digging work with picks and mattocks, which were also discovered on the site.

Flakes struck off tusks after grooving with a burin achieved a more regular shape. One of these struck from a tusk after longitudinal grooving (fig. 77.2A–B) had two large facets on it indicating two hard blows with a chisel. One of these is on the external face of the ivory, and this raises the problem which blow actually detached the flake. Most of the indications suggest that the flake came off from a blow delivered at the bottom of the facet on the concave side of the blade.

e. Longitudinal and transverse division of bone with a burin

A more difficult, but technically more accomplished, method of dividing bone transversely and longitudinally in upper palaeolithic times was by cutting with a burin. The invention of the burin in this period, as mentioned above, can be regarded as a very great step forward in the field of technology. In order to appreciate this fact fully attention must now be turned to the full flowering of manufacture of bone tools in upper palaeolithic 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. In upper palaeolithic times 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.

The presence of burin facets is the distinctive trait of burins, although only a single vertical blow was necessary to make the working end, which could be done on a simple blade. Even when we have a medial burin made by two facets the working part may well be a corner angle produced by a single facet.

Eskimo burins used on bone are based on this principle. They have one working face, and are made of forged iron sharpened and then set in wooden handles. Different shapes are used for different kinds of work: straight burins for dividing materials, and hooked for making deep slots in bone objects.[1]

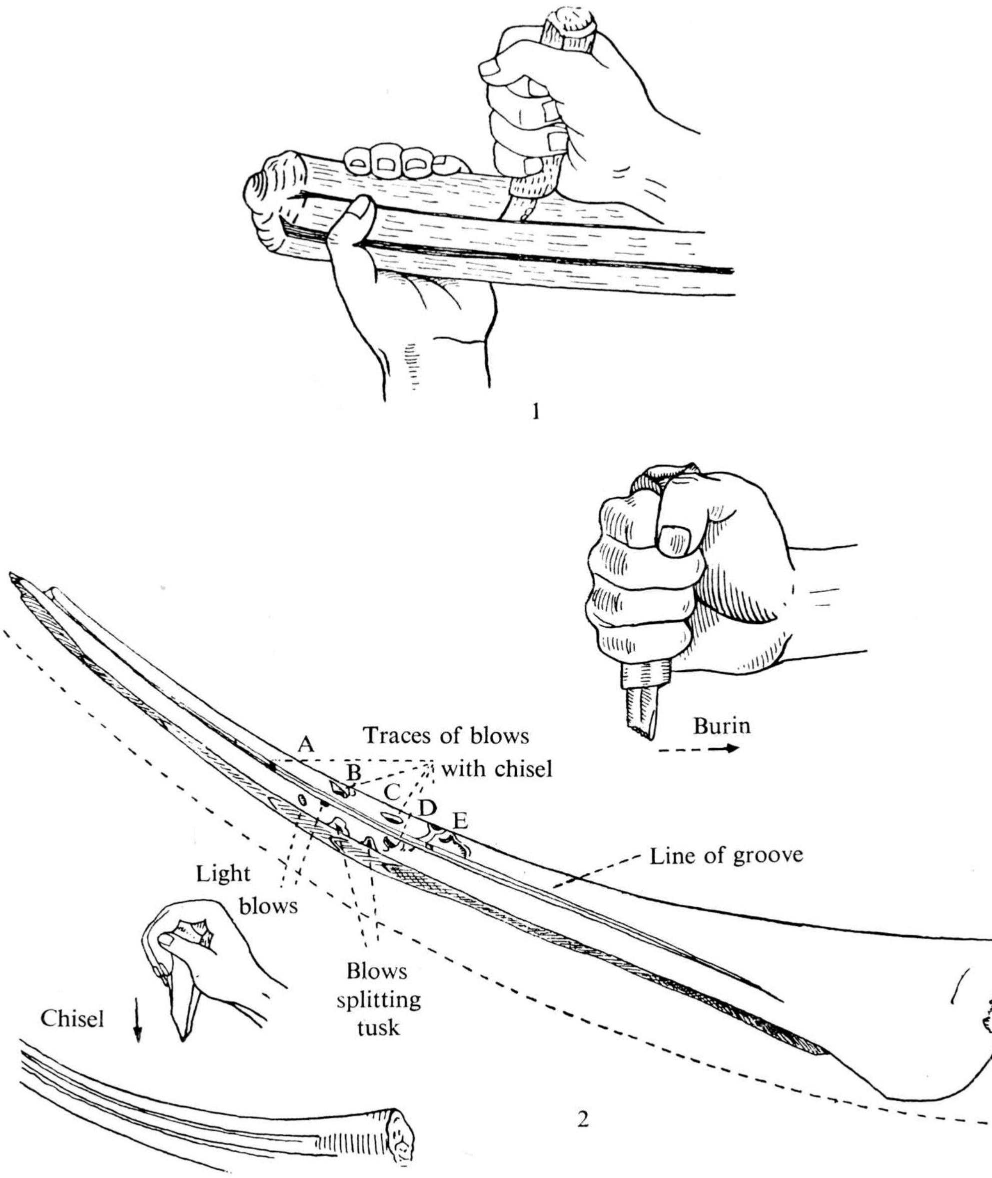
The mechanical principle of operation with an upper palaeolithic burin, made on a prismatic blade by a burin blow, amounts to this: the bone is not scratched but the burin angle takes a fine paring off it, in just the same way as a modern steel burin does in working on metals. Cutting bone with a knife as envisaged by Gerasimov[2] would be very difficult (fig. 78.1). A knife blade can whittle bone taking off a thin paring, but it cannot pass through its hard body in a longitudinal movement as, for example, it passes through meat or skin.

A burin was widely used for the transverse severance of ivory in upper palaeolithic times. In examining the material one is at once struck by shallow notches which pass a third or a half or the whole way round the circumference of the tusk. Usually they penetrated one layer of ivory, at most two, after which the tusk had been broken through. Instances never occur of the ivory being cut right through by the burin; undoubtedly this would have been superfluous, as the circular groove ensured a relatively straight break along the prepared line. The break would not be absolutely regular, but the main objective was achieved. As an example of notching a dagger handle from Eliseevich may be cited where the groove passed round two-thirds of the circumference. The fracture line in the inner layers of ivory makes a sharp zigzag (2 cm) on the side away from the groove (fig. 74.5).

Cases have been noticed when even a circular groove in the ivory did not give a regular line of division, but they are probably attributable to uneven drying-out through the tusk's section.

Very often longitudinal division of ivory was undertaken with the object of getting rough-outs.[3] A very remarkable specimen of longitudinal division along the whole length of a tusk by preliminary grooving with a burin may be cited from Eliseevich (fig. 78.2). Before us we have a long blade of ivory with traces of work on it. A long thin shallow groove, hardly penetrating beyond the ivory surface, extends practically along its full length. Approximately in the middle of the blade are traces of blows from a stone chisel showing the craftsman's

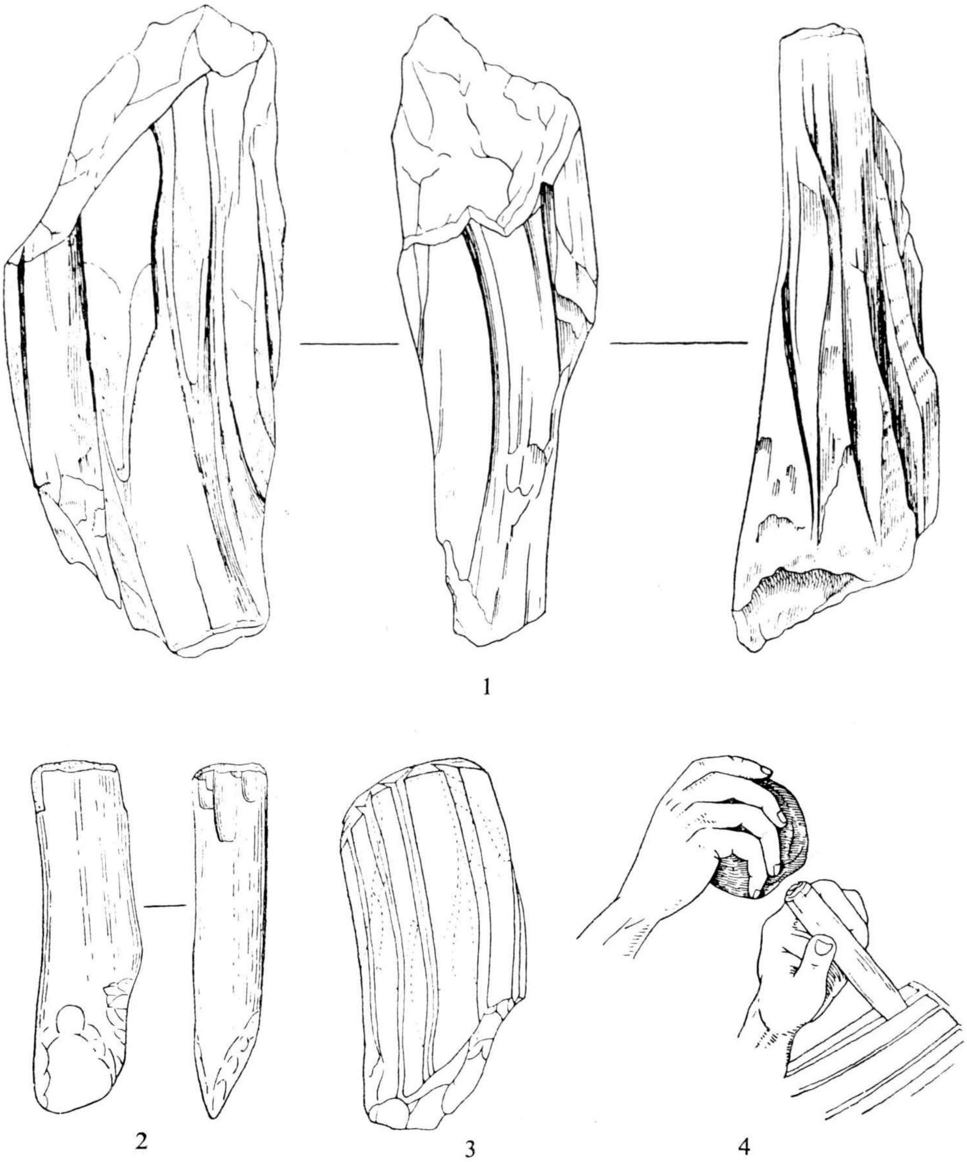
[1] J. W. Powell, *Annual Reports of the American Bureau of Ethnology* (1896–7), p. 81, pl. XXVI.
[2] M. M. Gerasimov, *Materials and Researches on the Archaeology of the U.S.S.R.*, 2 (1941), p. 73.
[3] A practically identical method of removing splinters from deer antlers was used in western Europe, although owing to the interior of antler being soft and friable blows were unnecessary to remove the splinter, as was the case with ivory; see *Proceedings of the Prehistoric Society*, 19 (1953), pp. 148–60. T.



78 *Longitudinal division of mammoth ivory:* 1 *Gerasimov's reconstruction of cutting ivory with a knife;* 2 *fragment of mammoth tusk from Eliseevich with traces of cutting and splitting along a prepared groove.*

intention to strike in the line of the groove in order to take off a strip along its whole length. Of traces of ten dents visible two are not connected with detachments of this strip; they were due to blows used in detaching a previous one off the left side. Two small dents indicate blows of quite insufficient force. Five dents (A, B, C, D, E) are connected with this strip, but clearly show that the craftsman had not considered the matter sufficiently. Of the five, four had not fallen on the proper line, only one being in the right place, but of insufficient strength. Work had then been abandoned on the tusk while still unfinished, so leaving interesting evidence for us today to study the methods of working bone used by palaeolithic man.

A fragment of tusk from Timonovka that has been studied deserves special attention for the signs of trans-



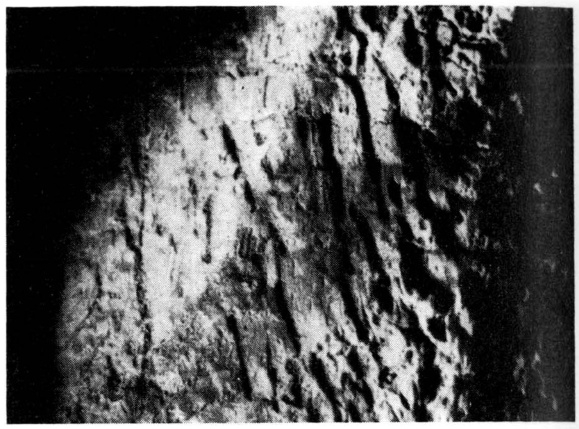
79 *Longitudinal division of mammoth ivory:* 1 *tusk fragment from Timonovka with traces of cutting and splitting;* 2 *antler chisel for splitting along a groove from Malta (Siberia);* 3 *grooved tusk from Malta;* 4 *method of splitting along the groove reconstructed.*

verse and longitudinal division that it bears (fig. 79.1). At one end the tusk has been hewn through without any visible traces of the use of a notch or burin; evidently the ivory was fresh when worked as indicated by the conchoidal nature of the fracture on the stump. At the other end it had been severed, using a very deep notch made with a burin.

Longitudinal grooving of the tusk was designed to produce regular strips by making deep parallel grooves at intervals of 15–20 mm, the rough-outs made in this way being employed for objects whose nature is uncertain. The secondary work was done with ivory that was fairly dry, after the lapse of some time since the transverse severance of the tusk.

After he had made the longitudinal grooves the palaeolithic craftsman had to split off the strip. How-

2



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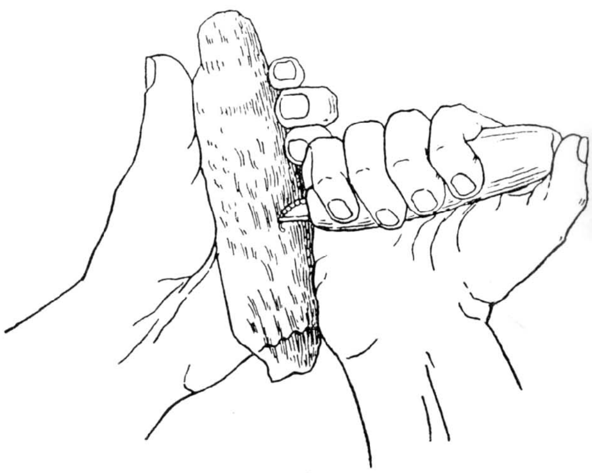

4

80 *Upper palaeolithic female statuette carved of mammoth ivory from Avdeevo:* 1 *general view;* 2 *traces of whittling with a flint knife at the head (enlarged);* 3 *traces left by use of burin on the back (enlarged);* 4 *method of carving reconstructed.*

ever, strips would not split off along their whole length but broke more or less centrally, in spite of some of the grooves being undercut, so as to differentiate the strip to the maximum and ease its detachment.

There are no grounds for believing that in splitting off the strip a single striker stone only would have been used. The reconstruction shows a lump of grooved ivory before the strip has been split off, assuming that a bone wedge was put into the groove (fig. 79.4); the Eskimos split walrus ivory in this fashion. The existence of a chisel of Eskimo type has been established in some palaeolithic sites (Afontova Mountain, Kostenki I, Malta). The chisels have a thick battered butt end with scars from blows on the edge and a wedge-shaped working end (fig. 79.2).

f. Plastic work with a burin

There are other facts showing the wider use of the burin by palaeolithic man; it was also used for sculptural work. A statuette from Avdeevo studied in this connextion has traces on its surface of whittling with a knife and clear furrows cut with the angle of a burin that show best on the body and legs (figs. 80.2–3). In this case a burin has been used not only for notches and hollows on the figure but also for removing surplus material, smoothing off the contours and modelling details (fig. 80.3).

The character and disposition of the furrows makes it possible to infer that the burin was held with the edge of the palm of the right hand pressing on the ivory, and short movements made by squeezing the fingers with slight assistance from neck and shoulder muscles (fig. 80.4).

Thus upper palaeolithic man made use of techniques of grooving and burin work for purposes as different as obtaining a bone rough-out on the one hand, and sculpture on the other.

g. Whittling

Traces of whittled bone indicate that this method of work was well understood in upper palaeolithic times. Two methods of whittling can be distinguished. One can be described as a sort of scraping with the flint blade held almost at right angles to the bone surface. The traces on the bone consist of parallel lines slightly wavy and at closely spaced intervals characteristic of this type of work. An example is an object from Kostenki I conventionally called a 'boomerang', which has been made from a mammoth rib with the curve taken out and the edge sharpened by whittling. In this instance the whittling was of a distinct kind, whose purpose was to take off an appreciable quantity of the material by means of a frequently repeated movement. The so-called boomerang from Kostenki I is of considerable length, about 80 cm, and its breadth in the middle is about 7 cm. In transverse section it is rhomboidal. The epiphysis has been removed and the edge sharpened by whittling. At this end on the concave side are traces of chops made with a stone axe, whose significance is uncertain.

In reality this object probably is not a boomerang but a throwing club for hunting birds, not one which returned to the feet of the hunter if he missed. In ethnographic souces there is widespread record of such clubs which have a circular flight and, used on a flight of birds, can kill several of them.

In 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 kind of work is the working of wood with a knife and plane in contemporary peasant industries. On palaeolithic bone articles similar surface alterations are visible characterized by facets, notches, cuts, 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.

h. Softening bone

Almost all the methods that have been described of working ivory, antler, and long bones were employed by palaeolithic man without altering the natural quality of the material. Sodden bone, as is well known, possesses a fair degree of plasticity and viscidity, which given patience and skill would allow it to be worked with flint tools.

Undoubtedly there was no necessity to soften the bone of a freshly killed animal when splitting, grooving, incising, whittling or 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.

Ivory also is better split in a dried-out state, since the lamellae adhere less firmly and the tusk loses some of its monolithic character, but whittling and burin work would be very difficult on dried-out bone. This is easily confirmed by simple experiment, that is by using a flint or metal tool (knife or burin) firstly on a 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.[1] In our test the dried-out bone after soaking took up moisture that increased its weight by 7 per cent, demonstrating a relatively high degree of hydroscopicity. In this way working (whittling and burin work) on the bone was made appreciably easier; parings three to four times thicker could be taken off.[2]

There are grounds 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

[1] The translator can confirm by tests that this was also so with antler. In 1952 at Cambridge a section of reindeer antler was tested with a micro-hardness tester. Three sets of readings were taken diametrically across the antler: twenty readings on the dried-out antler, six after one hour's soaking at 80°C. and fifteen after 89 hours drying-out in still air. The mean hardness values were respectively 37·35, 19·9 and 31·13. Thus after an hour in hot water the antler's hardness dropped to 53 per cent of the original, but it returned to 83 per cent of the original after 89 hours drying. T.

[2] The translator might point out that softening of bone, antler and ivory, prior to carving, was generally practised on both sides of the Bering Straits, with urine among the Koryak and by boiling among the Alaskan Eskimo; see: *Annual Report of the Bureau of American Ethnology*, 18, pt. i (1897), p. 196, and W. Jochelson, *The North Pacific Jesup Expedition*, vi, The Koryak, pt. ii (1908), p. 647. T.

quickly, employing complicated and laborious techniques only of necessity, when normal methods did not give the required results.

There exist, however, undisputed facts demonstrating the softening of bone by steaming. In this connexion a diadem from a child's grave at Malta must be cited, which consisted of a hoop made of a thin strip of ivory. Fresh ivory could not possibly have been bent into a hoop thus, and it would have been difficult to flake off a strip like this because of its lamellar structure. In order to obtain such a strip it would be necessary to use dry ivory, and then force it into the necessary curvature.

Gerasimov with good cause considers that in order to obtain such shapes palaeolithic man resorted to steaming. If damp bone had been 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.

In contemporary peasant techniques the softening of bone is carried out by steaming in a damp medium at a temperature of 120°C or higher.

Palaeolithic man not having the use of clay vessels probably first soaked the bone for a long time and then heated it up over a fire.

Gerasimov's experiments showed a very feasible method of softening ivory: 'After thorough soaking for five days a lump of ivory 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 ivory 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 flint blade giving long spiral-like parings. An ivory strip could be easily bent after steaming in this way.'[1]

2. The manufacture of bone points in the settlement of Luka-Vrublevetskaya

THE study of traces of use on artefacts permits us to detect the consecutive stages of manufacture of this or that object, even if only fragments of it have survived.

An example of this is the manufacture of bone points studied in the material from the early Tripolye settlement of Luka-Vrublevetskaya.

The points were made out of long bones: first one epiphysis was knocked off, and then grooves were cut with a burin along the shaft of the bone so as to make four rough-outs from each bone. The bone was split into narrow strips along these grooves for their full length including the remaining epiphysis. The thickened end of the latter served as a handle, which was trimmed only after the final work on the tapering part of the tool. The next step was to work the rough-out on a rough stone block to remove superflous material and grind the bone into shape. The final stage was to sharpen up the tip on a fine-grained stone plaque, a touch-stone.

The stages enumerated are represented in traces of wear shown in the photographs. Traces of longitudinal grooves are visible in the front and side edges of the bone (fig. 81.1, 3). They start at the epiphysis and run as parallel lines gradually deepening; their number indicates the number of movements made with the burin, which very often penetrated the interior of the bone at first cut.

Traces of the rough grinding are visible in the micro-photographs (fig. 81.4) as diagonal lines intersecting at a slight angle. They are situated on the side edges of the rough-out previously marked by the parallel lines of the burin movement. Evidently grinding against a stone was very efficient and the bone wore down very quickly, so there was no necessity to resort to whittling.

The final work of forming the tip was done more carefully on a stone of finer grain, as shown by the regular lines which hardly intersect (fig. 81.6).

81 (OPPOSITE) *Methods of manufacturing late neolithic bone points at Luka-Vrublevetskaya:* 1 *traces of splitting along prepared grooves cut in the diaphyses;* 2 *bone strip with traces of grinding on an abrasive stone;* 3 *traces of parallel cuts for grooves;* 4 *micro-photograph of traces of grinding on a coarse-grained stone;* 5 *finished points;* 6 *micro-photograph of traces of sharpening a point on a fine-grained stone.*

[1] M. M. Gerasimov, op. cit., pp. 70–71.