EXPERIMENTAL ARCHAEOLOGY: JOURNEYING INTO PREHISTORY

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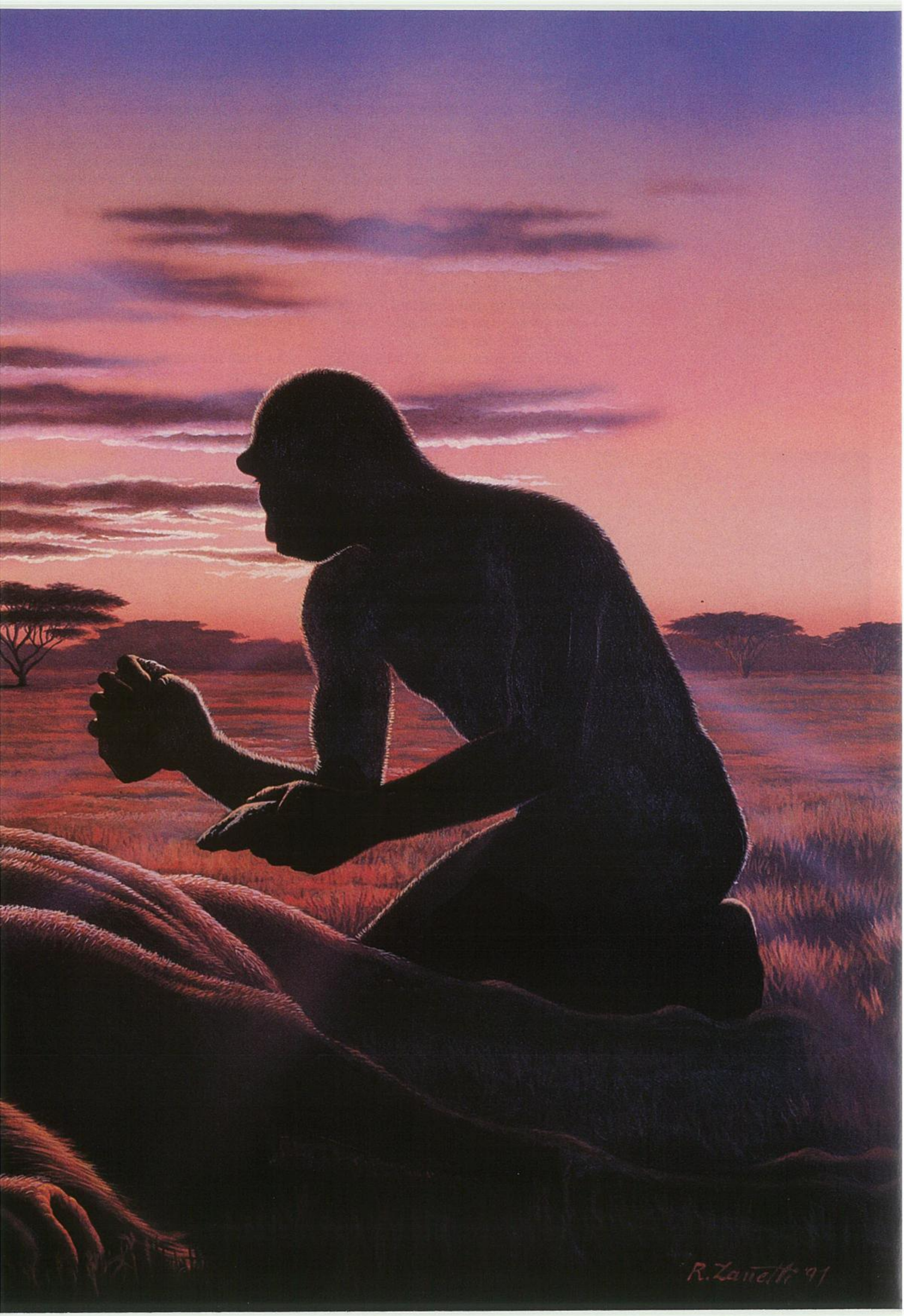


Imagine being dropped in the grasslands of tropical Africa without transport, clothes, or tools of any kind. You must eke out a living by exploiting the local resources and making rudimentary implements to help you in these activities. Doubtful. Yet this is something that our earliest tool-making hominid (proto-human) ancestors did on a daily basis. Our understanding of what their lives were like in thie remote period of time is as yet imperfect, but the challenge to archaeologists of human origins is to increase this understanding and refine our view of how we survived and adapted in our remote prehistoric past.

Traditional approaches to studying the past have concentrated on archaeological field work and analysis, that is, getting artifacts and other prehistoric materials from the ground and analyzing them in the laboratory. More recently there has been growing emphasis on experimental archaeology, which attempts to recreate aspects of past lifestyles in order to understand better the dynamic activities and processes that help form and shape archaeological sites. In this way we are able to look directly at a variety of possible behaviors of our ancestors and the "signatures" that they would leave in the archaeological record; we can then look for these signatures in our excavated sites and identify actual prehistoric activities, bringing the past "to life".

Our work has concentrated on the experimental archaeology of the early stone age of Lower Palaeolithic. This technological period includes the

Un elefante morto per cause naturali viene macellato con l'aiuto di strumenti litici di tipo primitivo. È possibile, quindi, macellare il più grande mammifero della terra con i più semplici strumenti di pietra scheggiata, simulando così il comportamento dei primi ominidi.

An elephant that has died through natural causes is butchered using primitive-like stone axes. This proves that even the largest mammals can be butchered using the simplest of flaked stone tools as the early hominids were presumably able to do.

world's earliest stone tool assemblages from Africa (called the "Oldowan" pebble-tool industries after the famous site of Olduvai Gorge in Tanzania) which first manifests itself about 2.5 million years ago. A major technological change in the prehistoric record subsequently begins about 1.5 million years ago called the "Acheulean" handaxe/cleaver industries named after the site of Saint Acheul on the Somme River in northern France, first described in the 19th Century.
At least three fossil species of upright-walking proto-humans existed between 1.5 and 2 million years ago: the small-brained, large cheek-toothed *Australopithecus boisei,* which went extinct by one million years ago; the larger-brained *Homo habilis,* first appearing about two million years ago and evolving into its presumed descendant *Homo erectus* by about 1.6 million years ago. *Homo erectus* subsequently spread from Africa into Eurasia by 1.0 million years ago. At present it is impossible to know which species was the primary tool maker at a given point in time, altough it is suspected by many anthropologists that the larger-brained genus *Homo* representatives were the more intelligent, omnivorous tool-makers during this time period. At that time much of East and South Africa was grassland, with wooded areas especially along the major of river courses. A range of extinct animal forms roamed this ancient landscape, including many species of antelope, as well as giraffe, rhino, elephant, buffalo, large cats, hyaenas, pigs, baboons, as well as the hominids (pro-human forms). The best approach towards understanding how and why stone artifacts were made in a certain way is to try and replicate these forms using exactly the same types of stone, techniques, and strategies that were employed by ancient tool-makers. This was undertaken for the Oldowan and Acheulean industries of the Old World. Some interesting conclusions have been drawn from this research.
Traditionally, the so-called "core-tools" of Oldowan technologies were the focal point of most archaeological attention. These were often assumed to be the principal implements used by early hominids, and their forms arrived at by predetermination, making them stylistic target forms (sometimes called "mental templates") of these

Con una semplice scheggia di pietra lavica si taglia la pelle di un elefante che è spessa 2 centimetri.

Two-centimetre thick elephant skin can be cut with a simple lava-stone flake.

early technicians. The flakes that were detached from these cores were classified as "waste" by-products. Experimentation suggested that most of these "core tool" forms could be arrived at by simply manufacturing flakes by striking them off cobbles with a stone hammer, and that no necessary predetermination was required to produce them. Thus, the size, shape, and type of rock used could have a profound effect on the final core form.

There also appeared to be evidence that these early tool-makers were operating in more complex ways than do modern chimpanzees. It can be documented that Oldowan tool-makers sometimes transported rock tools up to several kilometers from their geological sources. Secondly, computer simulations based on tool-manufacture experiments and refitting studies of excavated archaeological material indicate that these Oldowan hominids were leaving later stages of the flaking of cobbles at prehistoric sites in higher than expected frequencies. This suggests that these creatures were in the habit of carrying tools with them from place to place, collecting these materials in large numbers at focal points on the landscape. This also suggests much more foresight than is exhibited among modern apes.

With the advent of the Acheulean about 1.5 million years ago (roughly coinciding with the emergence of *Homo erectus*), new technological patterns can be seen in the prehistoric record: large flakes are being struck from boulder cores and then shaped into standardized handaxe and cleaver forms.

Experimentation has demonstrated that later examples of handaxes require more sophisticated cognitive operations for their production: thay show very refined workmanship and a clear sense of bilateral symmetry. This technology eventually spreads to much of the Old World, with the characteristic Acheulean handaxe and cleavers being made out of large flakes of lava, quartzite, quartz, or silicified limestone or out of nodules of flint, depending on what was available in the region.

From an evolutionary standpoint, we are especially interested in the adaptive significance of these new technologies. It appears that stone tools allowed our hominid ancestors to adapt to a wide range of geographical and environmental conditions, and ultimately aided in our penetration into the Eurasian landmass by about one million years ago. A major question presents itself: for what vital tasks and functions were these tools used?

To help answer this question, replicas of early stone tools were manufactured and then experiments were conducted to test the efficiency of each type of tool in various tasks, such as woodworking, hideworking, and animal butchery (the animals had died of natural causes). Based upon these experiments, a more realistic assessment of the potential of prehistoric stone tools was possible.

Further indications of prehistoric stone tools function include cut-marks on joints and areas of meat attachment on animal bones, a clear sign of processing animal carcasses with sharp cutting tools, and fracture patterns on animal limb bones which indicate the use of a stone hammer to crack open the bone for the edible marrow inside. Microscopic polishes on stone tool surfaces and damage patterns on stone tool edges can also be indicative of tool function.

We are also investigating the possibiliy of detecting organic residues such as DNA on stone implement surfaces which could be indicative of tool use as well, although this research is in its infancy.

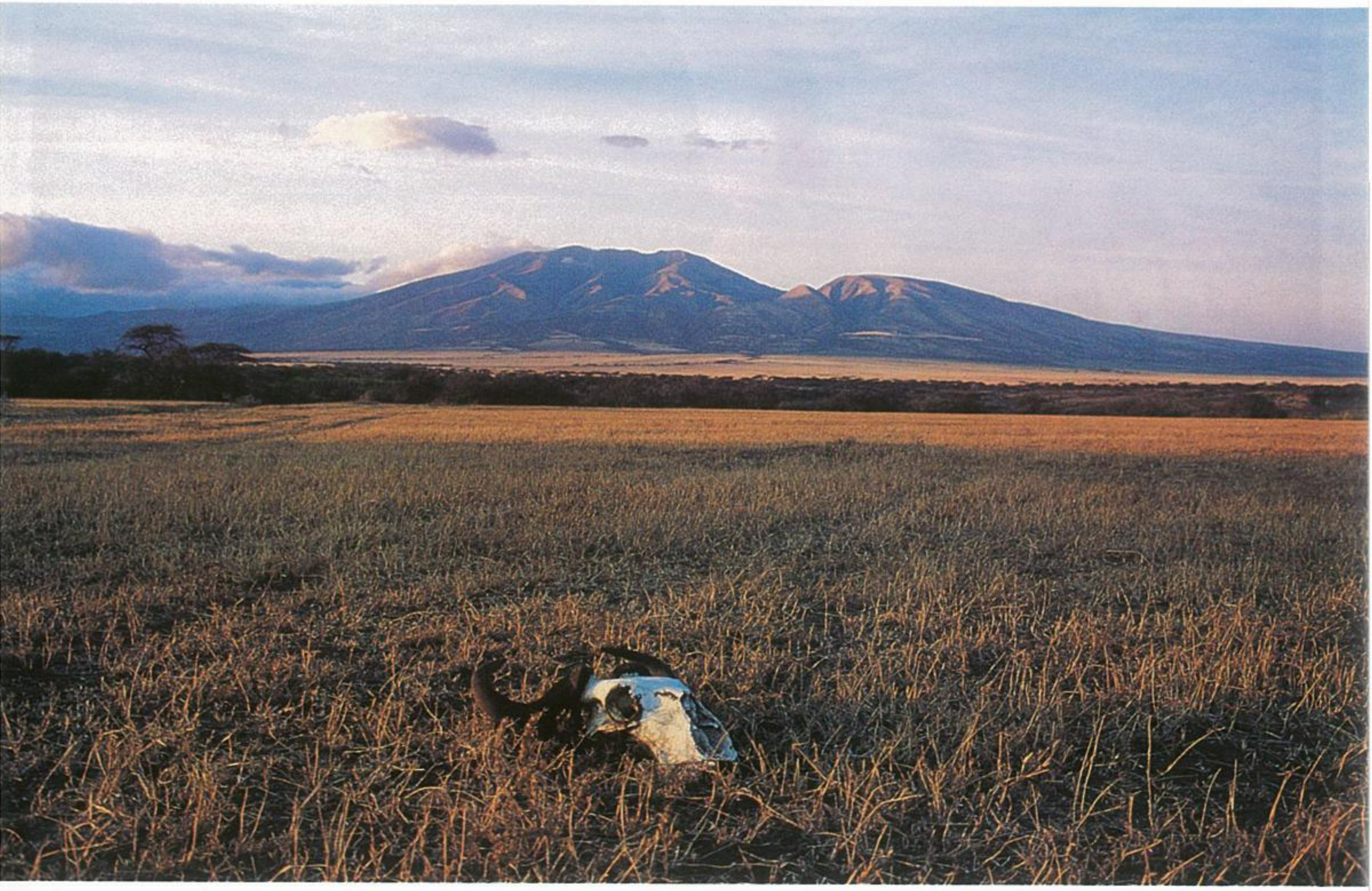
At some lake margin sites, cut-marks on animal bones have been discovered without the presence of stone tools. Our experimentation has shown that mollusc shells could have served as reasonably efficient butchery knives in the absence of stone and also leave cut-marks on bones.

Stone technology is one of the few ways that we can attempt to assess the level of intelligence and cognitive sophistication of these early hominid groups. As mentioned above, it would appear that these early stone age hominids were cognitively more sophisticated than non-human primates, including chimpanzees, are today. Although the types of artifacts they produced were simple, the operations involved in flaking stone require an intuitive sense of geometry that recognizes acute angles on cores (necessary for controlling flaking). Together with the evidence for a good deal of stone transport in this early stage of our prehistoric, this reveals a significant expansion in our cognitive abilities and a tendency to plan ahead for future events by at least 1.5 to 2 million years ago.

One unexpected finding was that these early hominid populations appeared to have been strongly and preferentially

La savana al tramonto. Il bucranio è il simbolo dell'eterna lotta tra prede e predatori.

Dusk savanna. The bucrane (ox's skull) symbolizes the eternal struggle between prey and predator.



right-handed, a pattern seen in modern humans but not in other mammals: we are approximately 90% right-handed today. The finding that early tool-making hominids were right-handed was based on the types of flakes that had been struck from cobble-cores. A right-handed individual normally holds the stone hammer in the dominant right hand for power and control, while the left hand holds the core to be worked. When a sequence of flakes are removed from the core, there is a natural tendency to rotate the core in a clockwise direction because of the biomechanical operations of the left hand.

The flakes that are detached will have cortex (the weathered outside rind of the cobble) preferentially on the right side, with one or more scars on the left hand side from previous flake removals on the core. Our experimental flakes (produced by right-handed flaking) and the archaeological sample both have approximately 57% "right-oriented" flakes and about 43% "left-oriented" flakes, which is statistically very significant with a large sample size.

The significance of right-handedness in modern humans, let alone prehistoric hominids, is not understood. Many scientists believe that this handedness in an indication of a more profound lateralization (specialization of tasks) of the two hemispheres of the brain during the course of human evolution. The left hemisphere of most people today is related to time sequencing and language ability (as well as

Sopra, spaccatura di un osso di bovino con un chopper di pietra lavica per estrarne il midollo.

Above, breaking a bovine bone with a lava-stone cleaver to extract the marrow.

*Pagina accanto, un'eccezionale fotografia: al Centro di Ricerca del Linguaggio di Atlanta, Georgia, Kanzi, uno scimpanzé pigmeo (*Pan paniscus*) costruisce strumenti in pietra scheggiando un pezzo di selce con un percussore litico. Lo scimpanzé usa le schegge affilate come attrezzi per tagliare una corda che sostiene una scatola contenente un pezzo di frutta. Kanzi è il primo primate che ha imparato a scheggiare strumenti litici come i nostri antenati dell'età della pietra. (Foto di Rose A. Sevcik).*

*Opposite, an historic photograph. At the Atlanta Language Research Center, Georgia, a pygmy chimpanzee (*Pan paniscus*) makes stone tools by flaking a piece of flint with a stone hammer. The chimpanzee uses the sharp flakes to cut a cord holding a box containing fruit. Kanzi is the first primate to have learned to flake stone tools as our stone-age ancestors did. (Photo by Rose A. Sevcik)*

controlling the dominant right hand), while the right hemisphere is more involved with spatial perception. Evidence for right-handedness seems to agree well with analyses of fossil skulls of *Homo habilis* between 1.5 and 2.0 million years ago, which indicate a more profound asymmetry of the two sides and more pronounced developments of cerebral cortical area involved with language ability.

Before we can critically examine the spatial distribution of stones and bones from prehistoric stone age sites and look for behavioral evidence, we must first ascertain whether these sites are in fact more or less as the hominids left them, or whether these sites could have been significantly disturbed or rearranged by geological forces before final burial.

In order to gain a better understanding of the complexities of site formation and burial, dozens of experimentally simulated palaeoloithic sites were set up in a range of East African geographical environments: stream floodplains, stream channels, lake margins, hillslopes, etc.

Each "site" consisted of experimentally-made stone tools as well as modern animal bones. A sample of these materials were painted yellow for easy detection, or coated with aluminium foil so that they could be located with a metal detector after burial.

Over a period of five years these sites were monitored to see the effects of river floods, rising and falling lake levels, slope wash, etc.

Sites were excavated after being buried to see how much disturbance and rearrangement had taken place.

These studies provided a set of criteria to judge whether prehistoric stone age sites had been seriously affected by geological forces.

Based on this research, it is becoming clear that early stone age sites range from almost pristine to very heavily reworked by strong water action before burial.

It is essential to discriminate between those sites that have the potential to yield behavioral information and those that do not.

At present, there is a raging debate over how early stone Age sites were created. Were they "home bases" or camps such as we find among present-day hunter-gatherers, from which male and female groups might have radiated during the day for food which they then brought back to camp at night to share and consume? Or might we have been scavengers raiding the dens and kill sites of carnivores, such as lions, leopards or hyaenas, where we left behind the tools we brought for this purpose? Or are these sites rather caches of stone that we built up so that we wouldn't have so far to carry meat we had scavenged? At present time there is no clear solution to these questions, but there are some things that we can say: the mere size of some of these sites, sometimes comprising hundreds of pounds of stone artifacts not to mention similar or even greater quantities of bone, would argue against caching stones to economize on energy spent. In fact, the consistent pattern of stone transport we have detected indicates that stone was very often carried around as the hominids went from site to site. It is likely that the very large sites we see developed at places with abundant resources, which the hominids visited quite often, transporting and leaving some of their tools behind each time they moved on.

We feel that an evolutionary shift in one branch of hominids between two and three million years ago included more animal foodstuffs in the diet. To facilitate the processing of animal carcasses the use of flaked tools became an essential part of the behavioral repertoire of these proto-humans, and for the first time in the history of the Earth an emphasis on technology through learning became an essential part of the adaptation of this lineage.

The shift towards increased omnivory, tools, and more complex social interaction set a premium on intelligence, partially reflected in larger brain size; through time, those individual with a higher intelligence would survive and reproduce at a greater than average rate than others in the population, so that any biological trait that would increase efficiency in learning, tool making and tool use, and scavenging or hunting would be selected for.

These simple technologies set the foundations for all human accomplishments. As technology, language, and social interactions developed, through time hominids learned to domesticate fire, build more substantial structures, fix stone implements onto shafts or handles, stitch clothing, paint and carve images, fire ceramics, domesticate plants and animals, and achievements of the 21st century, it is somewhat humbling to appreciate that these magnificent leaps in human progress were dependant upon the simple, first crafts of our ape-like ancestors.

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Dopo il temporale, un arcobaleno appare sulla savana del Serengeti in Tanzania.

After a storm, a rainbow appears over the Serengeti savanna, Tanzania.